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# THE VEGETABLE OILS AND FATS INDUSTRY IN DEVELOPING COUNTRIES: OUTLOOK AND PERSPECTIVES

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This document presents major results of work under the element Studies on the Food Processing Industries in UNIDO's programme of Industrial Studies 1984/85.

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Preface

The present study has been prepared by UNIDO's Division of Industrial Studies, Sectoral Studies Branch, with the aim of assessing the present contribution of the developing countries in the vegetable oils and fats industry and to present some elements of strategies for the further development of the sector in developing regions.

The study will be a background document to the Second Consultation on the Food Processing Industries to be held in Copenhagen from 15 October through 19 October 1984. Additional background statistical information on the sub-sector is given in Volume 2, entitled "Statistical Digest on the Vegetable and Oils Industry".

FAO and UNCTAD have collaborated with UNIDO in this study. FAO has provided statistical information and advice on production, trade and consumption useful for chapter 2, 3 and 4, UNCTAD has prepared an analysis on tariff and non-tariff measures on the world oilseed, vegetable oils and related products, which was used as a basis for discussion of chapter 3 and which will be issued as a separate document. UNIDO is grateful for this valuable inter-agency co-operation. The description and analysis presented in chapters 5 to 8 is largely based on work undertaken by the Tropical Development and Research Institute of London, England.

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## EXPLANATORY NOTES

References to dollars ($) are to United States dollars, unless otherwise stated.

A comma (,) is used to distinguish thousands and millions.

A full stop (.) is used to indicate decimals.

A slash between dates (e.g., 1980/81) indicates a crop year, financial year or academic year.

Use of a hyphen between dates (e.g., 1960-1965) indicates the full period involved, including the beginning and end years.

Metric tons have been used throughout.

The following forms have been used in tables:

Three dots (...) indicate that data is not available or is not separately reported.

A dash (-) indicates that the amount is nil or negligible.

A blank indicates that the item is not applicable.

Totals may not add up precisely because of rounding.

Besides the common abbreviations, symbols and terms and those accepted by the International System of Units (SI), the following abbreviations and contractions have been used in this report:

### Economic and technical abbreviations

| | |
|---|---|
| GNP | Gross national product |
| ISIC | International Standard Industrial Classification of all Economic Activities |
| SITC | Standard International Trade Classification, Rev. 1 |
| TNC | Transnational corporation |

## Organizational abbreviations

| | |
|---|---|
| UN | United Nations |
| UNIDO | United Nations Industrial Development Organization |
| FAO | Food and Agriculture Organization |
| UNCTAD | United Nations Conference on Trade and Development |
| UNSO | United Nations Statistical Office |
| ITC | International Trade Centre |
| TDRI | Tropical Development and Research Institute |
| JUNAC | Junta del Acuerdo de Cartagena |

## Glossary

**Fats and oils:** are substances of plant or animal origin which consist predominantly of triglyceryl esters of the fatty acids, or triglycerides. In general, the term "fat" is used in reference to materials which are solid, or more properly, semisolid, at ordinary temperatures, whereas the term "oils" is reserved for those which are liquid under the same conditions. However, it is obvious that no rigid distinction can be made between the two, and here the common practice will be followed of using the terms interchangeably, except where a distinction between solid and liquid materials is important.

**Total edible fats and oils:** animal and vegetable oils and fats used for human consumption, as differentiated from those used exclusively for industrial purposes (some edible oils and fats can be used also for industrial purposes).

**Visible fats and oils:** are fats and oils separated from animal or vegetable sources. "Invisible" fats and oils are those derived from nuts, grains, seeds, meat, eggs, etc. that are consumed without separation.

**Oil equivalent:** the output of vegetable oils is calculated by applying extraction rates to the portion of the oilseed crop estimated to be available for crushing in that year, regardless of whether it is in fact crushed (either in producing countries or, after being exported in unprocessed form, in importing countries) or put into stock; output is thus not based on actual crushings.

**Apparent consumption:** does not refer to actually ingested fat (actual consumption data are not available) but to the supply available as estimated from data on production, trade and non-food uses.
Apparent consumption = Production plus imports - exports.

**Total fat apparent consumption:** applies to both vegetable and animal oils and fats.

**Dependency ratio:**

$$\frac{\text{Gross imports of total edible fats and oils}}{\text{Total apparent consumption}} \times 100$$

**Crushing:** in this report, the term is applied to both the mechanical and chemical separation of the oil from seeds, copra and fruits.

| | |
|---|---|
| Cake: | oil seed after oil has been expelled mechanically (pressing). |
| Meal: | widely used to describe oil seed after solvent extraction of oil. |

In this report the two above terms are treated as a single group of products.

| | |
|---|---|
| Domestic production of cake: | cake equivalent of the part of the total crop that is available for crushing, regardless of whether it is crushed in the producing country or exported in the unprocessed form for crushing in the importing countries. |
| 100 per cent protein equivalent: | an indication of the value of a cake or meal expressed in a 100 per cent protein basis. |
| ffa | Free fatty acids. |

Country groupings

Developing countries:

| | |
|---|---|
| Tropical Africa: | All of Africa South of the Sahara, except for the Sudan and the Republic of South Africa |
| Northern Africa, West Asia: | Rest of Africa except for the Republic of South Africa, and the Arab countries of Asia, and Iran, Turkey and Cyprus |
| Southern Asia: | Afghanistan, Bangladesh, Bhutan, Burma, India, Nepal, Pakistan, Sri Lanka |
| South-Eastern Asia: | Rest of Asia except for CPE Asia and Japan, plus the South Pacific Islands |
| Latin America: | South and Central America and the Caribbean, excluding Puerto Rico and the U.S. Virgin Islands |
| Centrally planned economies (Asia): | People's Republic of China, Democratic Kampuchea Democratic People's Republic of Korea, People's Democratic Republic of Lao, Mongolia, Vietnam |

European centrally planned economies:

Albania, Bulgaria, Czechoslovakia, German Democratic Republic, Hungary, Poland, Romania, USSR

Developed market economies:

| | |
|---|---|
| North America: | Canada, U.S. and U.S. territories |
| Western Europe: | Austria, Belgium, Luxembourg, Denmark, Federal Republic of Germany, Finland, France, Iceland, Ireland, Italy, Netherlands, Norway, Sweden, Switzerland, United Kingdom, Greece, Malta, Portugal, Spain, Yugoslavia, Israel |
| Japan: | Japan |
| Other developed: | Australia, New Zealand, South Africa |

## INTRODUCTION

The First Consultation Meeting on the vegetable oils and fats industry, held in 1977, called for further work on existing and future supplies of oil-bearing raw materials in the developing countries and on the identification of the main constraints to development of the industrial sub-sector. The present study is a response to that request.[1/]

The main objective of the study is to review the current status of the world vegetable oils and fats industry, to assess both the present position of developing countries within the industry and the related factors (positive and negative) contributing to that position, and to provide elements for planning the further development of this sub-sector within developing regions. The study focuses on changes that have taken place since the first UNIDO report on this sub-sector was published[2/] (the time period covered is 1976-1982), and refers specifically to the same oil-bearing raw materials that were considered in 1977.[3/]

Unlike the earlier study, the present report attempts to place more emphasis on analysing the industrial components of the system and their relationship with production, trade and consumption of oils and fats at the individual country level wherever possible.

In order to give a more dynamic picture of the developing countries' participation in the trade and industrial production of vegetable oils and fats, this paper introduces an analysis of trade flows of vegetable oils and fats, and an outline of apparent consumption patterns, at the country level,

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1/ Following the Consultation, UNIDO performed country evaluation survey of existing and future supplies of oilbearing raw materials for 12 developing countries. The information gathered was used for the present report.

2/ Draft World-wide Study on the Vegetable Oils and Fats Industry: 1975-2000, UNIDO/ICIS.46, 1977.

3/ Soya beans, cottonseed, groundnuts, sunflower seed, rapeseed, sesame seed, safflower, coconut, oil palm and palm kernels.

and projects consumption for the year 2000 for the different regions of the world. It also attempts, for the first time, to review installed industrial capacity at the crushing and refining stages, as well as the degree of capacity utilization and its possible relationship with selected constraints and advantages that may be attributed to other components of the system, including related national policies.

Structure of the report

A synopsis of the study is presented at the beginning of the report showing the present contribution of the developing countries, future opportunities up to the year 2000 and the constraints to be overcome for seizing these opportunities. Chapter 1 illustrates the role of the vegetable oils and fats industry in developing countries within the context of both other food processing activities and the manufacturing sector.

Chapters 2 to 4 of the study evaluate the changes that have taken place between 1976 and 1982 with respect to the production of oil-bearing materials, trade and apparent consumption. The geographical distribution of oil-bearing raw materials and their derivatives is outlined in chapter 2. Chapter 3 deals with international trade and pays special attention to the analysis of South-South trade through an evaluation of trade flows in constant values. Obstacles to trade are also discussed and an analysis is made of potential effects of tariff removal on the market for products from developing countries. In chapter 4, the relationship between levels of income and fat consumption patterns at regional and country levels intended as a contribution to a more detailed analysis of the potential growth of the world market of vegetable oils and fats, leads to projections of future consumption to the year 2000.

Chapter 5 contains an analysis of installed industrial capacity for 52 developing countries, with different levels of utilization and chapter 6 contains a discussion of the technical and economic factors and policies that are responsible for under-utilization. Chapter 7 includes a discussion of the role of transnational companies, advances and technical innovations introduced to the sector in the last few years.

The strategy of integrated industrial development, singled out as an important mechanism for accelerating industrial development in the food processing industries by the First Consultation Meeting in 1981, is discussed in chapter 8 as to its theoretical basis, elements and objectives.

A SYNOPSIS

By way of introducing the vegetable oils and fats sector and its relationship to agriculture and other industries, a schematic overview is presented in figure S.1 and S.2. The inputs to the sector come of course primarily from agriculture, but the chemical and capital goods sectors also play important roles (figure S.1). The industrially processed products originating in the vegetable oils and fats sector are numerous and varied, from soil conditioners to such consumer items as margarines and hair sprays (figure S.2). Although the present study covers only very few of these end uses[4/], they nevertheless account for some 80 per cent of the world's oil and fat consumption.

S.1 The present contribution of the developing countries

A review of developments that have taken place since the first UNIDO report was published in 1977, indicates that developing countries continue to play an important role in the global vegetable oils and fats industry. Their share in the world manufacturing of crude oils is twice as large as their share in the sugar industry and 10 times as large as the share in certain other food sectors of importance in the developing countries[5/] (table 1.2.).

The developing countries are now playing an increasingly important role in global crushing, importing more and exporting less oil seeds than in the middle of the seventies (table S.1.). Their shares in global oil and meal production have held steady whereas their consumption of these products has increased significantly relative to the rest of the world. Moreover, in the total production of oilseeds, their share has already reached the level projected for 1985 by FAO.[6/] But compared to 1976, their share in global

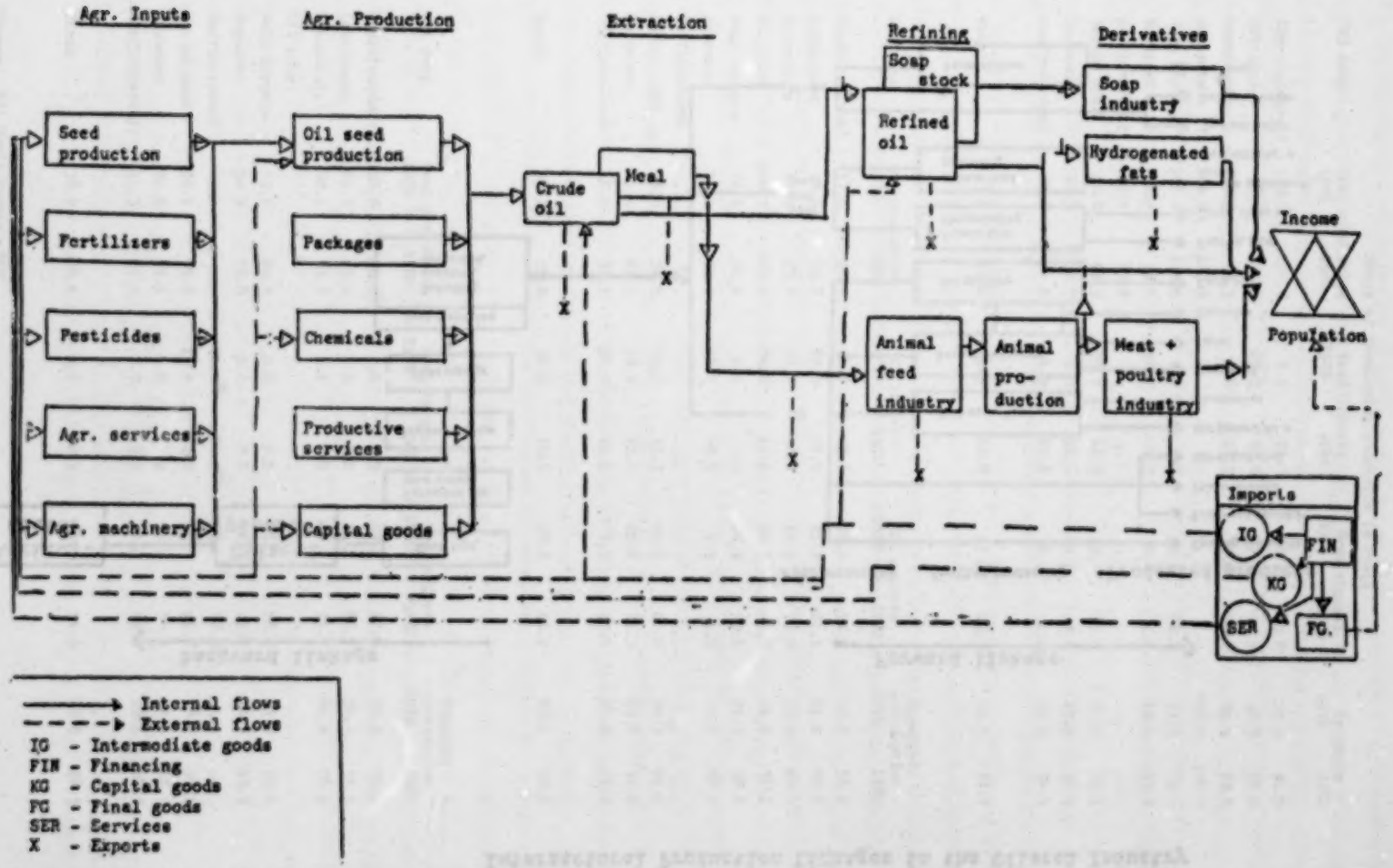
---

4/ Crude and refined oils, cakes and meals and toiletries.

5/ Slaughtering, dairy, canning and preserving of fruits, vegetable and fish, grain milling, cocoa and animal feeds.

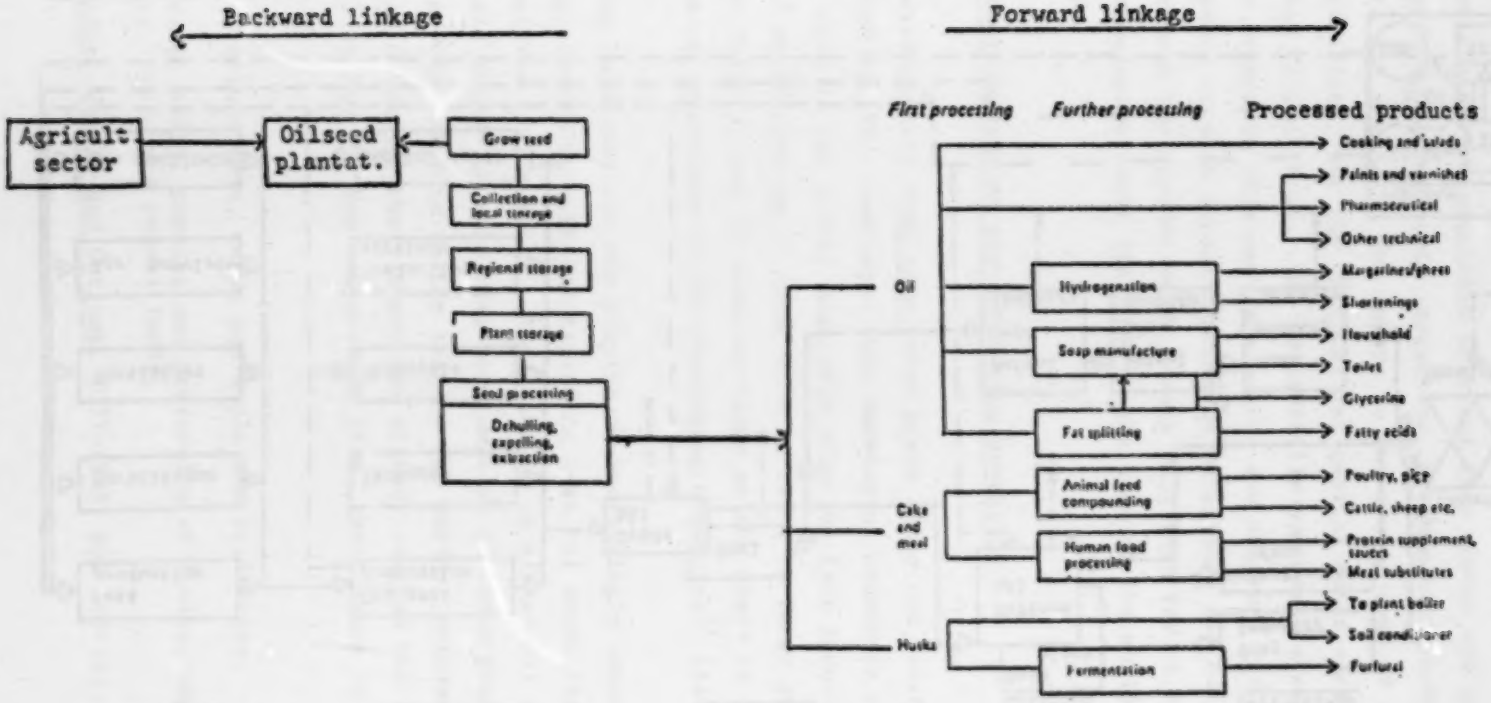
6/ FAO Commodity Review and Outlook, 1977-1979, pp. 107-122.

Figure S.1. Vegetable oils and fats agroindustrial system - basic scheme




Source: Based on: Metodologia de Evaluacion, Programacion y Gestion de Sistemas de Produccion y Consumo, Version Resumida, JUNAC, 1983

Figure 8.2.
Intersectoral Production Linkages in the Oilseed Industry




Source: Guidelines for the Establishment and Operation of Vegetable Oil Factories, United Nations, New York, 1977, pp 22 and 28

Table 8.1. Participation of developing countries in the world Vegetable oils and fats industrial flow: 1976-1982 (percentage)

| Oil crop | Share of developing countries in world: Seed production 1976 | Seed production 1982 | Seed imports 1976 | Seed imports 1982 | Seed exports 1976 | Seed exports 1982 | Crushing 1976 | Crushing 1982 |
|---|---|---|---|---|---|---|---|---|
| Copra(coconut) | 100.0 | 100.0 | 8.9 | 21.3 | 98.6 | 99.8 | 77.9 | 91.9 |
| Cottonseed | 57.6 | 61.3 | 48.9 | 28.6 | 42.1 | 73.7 | 56.9 | 58.0 |
| Groundnuts | 88.8 | 98.5 | 8.6 | 24.7 | 77.9 | 48.8 | 85.3 | 93.6 |
| Oil palm | 100.0 | 100.0 | | | | | 100.0 | 100.0 |
| Palm kernels | 100.0 | 100.0 | 6.9 | 3.2 | 99.8 | 98.3 | 73.1 | 93.1 |
| Rapeseed | 41.6 | 55.4 | 10.0 | 4.7 | 0.6 | 1.1 | 49.0 | 55.0 |
| Safflowerseed | 68.4 | 85.2 | ... | ... | ... | ... | ... | ... |
| Sesame seed | 99.8 | 99.9 | 39.8 | 40.8 | 99.6 | 83.5 | 95.4 | 95.1 |
| Soybeans | 42.3 | 30.7 | 8.8 | 16.4 | 20.2 | 10.4 | 22.3 | 30.2 |
| Sunfloverseed | 19.3 | 24.6 | 4.3 | 29.8 | 4.0 | 2.2 | 20.7 | 34.1 |
| Total | 53.4 | 47.6 | 9.5 | 16.8 | 27.2 | 12.7 | 45.5 | 51.9 |

| Oil crop | Oil production 1976 | Oil production 1982 | Oil imports 1976 | Oil imports 1982 | Oil exports 1976 | Oil exports 1982 | Apparent consumption 1976 | Apparent consumption 1982 |
|---|---|---|---|---|---|---|---|---|
| Copra(coconut) | 77.6 | 91.7 | 14.7 | 12.5 | 78.2 | 92.4 | 49.5 | 56.1 |
| Cottonseed | 53.6 | 56.2 | 82.3 | 87.0 | 11.8 | 21.1 | 61.1 | 66.5 |
| Groundnuts | 84.0 | 93.0 | 27.2 | 10.8 | 78.9 | 70.9 | 75.2 | 84.1 |
| Oil palm | 100.0 | 100.0 | 24.6 | 61.8 | 94.7 | 97.6 | 54.8 | 76.2 |
| Palm kernels | 71.4 | 92.6 | 9.5 | 9.0 | 84.9 | 93.8 | 27.3 | 38.4 |
| Rapeseed | 45.1 | 52.3 | 58.7 | 48.4 | 0.5 | 1.6 | 54.3 | 60.3 |
| Safflowerseed | ... | ... | ... | ... | ... | ... | ... | ... |
| Sesame seed | 95.0 | 94.5 | 22.5 | 35.3 | 55.8 | 60.0 | 94.5 | 94.0 |
| Soybeans | 21.9 | 25.7 | 59.3 | 72.4 | 29.6 | 31.3 | 23.5 | 41.0 |
| Sunfloverseed | 18.9 | 32.1 | 24.9 | 21.4 | 7.5 | 32.5 | 24.2 | 31.2 |
| Total | 54.1 | 55.9 | 34.6 | 40.6 | 58.8 | 61.2 | 44.1 | 52.5 |

| Oil crop | Meal production 1976 | Meal production 1982 | Meal imports 1976 | Meal imports 1982 | Meal exports 1976 | Meal exports 1982 | Apparent consumption 1976 | Apparent consumption 1982 |
|---|---|---|---|---|---|---|---|---|
| Copra(coconut) | 78.5 | 92.3 | 2.6 | 0.3 | 93.9 | 97.0 | 25.0 | 35.3 |
| Cottonseed | 61.7 | 63.4 | 2.0 | 3.8 | 81.1 | 86.5 | 54.0 | 57.7 |
| Groundnuts | 86.1 | 93.8 | 5.6 | 6.8 | 97.4 | 94.7 | 44.6 | 78.3 |
| Oil palm | | | | | | | | |
| Palm kernels | 73.6 | 93.4 | 0.0 | 7.2 | 78.3 | 98.8 | 23.6 | 29.4 |
| Rapeseed | 50.9 | 55.8 | 0.0 | 0.8 | 42.3 | 25.2 | 46.6 | 33.3 |
| Safflowerseed | ... | ... | 15.9[a/] | 16.1[a/] | 48.4[a/] | 50.3[a/] | ... | ... |
| Sesame seed | 95.7 | 95.6 | 19.4 | 50.1 | 98.5 | 96.7 | 88.2 | 93.1 |
| Soybeans | 21.6 | 29.5 | 6.6 | 13.9 | 40.1 | 44.9 | 12.6 | 18.7 |
| Sunfloverseed | 21.3 | 35.1 | 0.0 | 3.9 | 81.6 | 69.5 | 12.1 | 24.8 |
| Total | 38.9 | 39.5 | 6.6 | 12.3 | 54.5 | 51.5 | 22.8 | 28.3 |

Source: Oil World Weekly, FAO

a/ Data refer to Oilseed cake n.e.s.

seed production has declined due to the increasingly dominant role of the US soya bean production. Today the developing countries are crushing growing proportions of the oil-bearing materials they produce, thus reducing their formerly large exports of seeds and copra. In fact, they are now increasing their imports of seeds for domestic processing. These are results from policies aimed towards the promotion of local crushings in soya beans, palm kernels and groundnuts in countries like Brazil, Malaysia, India and many other minor producers.

In oil production the share of developing countries was maintained at the same time as world production increased by 11 million tons between the years 1976 and 1982, with greater participation in copra and palm kernels, a result of Philippine and Malaysian specific policies. But increasing imports of crude oils to the developing countries, together with constraints on the local production of seeds, have had a negative effect on the expansion of crushings and have increased the levels of idle crushing capacity, which in 1982 was estimated at more than 50 per cent, two to three times as much as in the industrialized countries. By 1982, the share in world oil consumption had surpassed the 50 per cent level and the FAO projection for 1985.

The consumption of cakes and meals is still comparatively low in the developing countries. But the animal feed industry is growing very fast in Asia, and also in Latin America, leading to increased consumption of cakes and meals. So far this increase has come from enlarged imports and decreased exports.

Trade plays an important role in the vegetable fats and oils sector. Two important factors contribute to this: the geographical concentration of oilseeds and oil-bearing materials[7/] and the dominant role being played by the United States, which alone produces a quarter of the world's oil production and one half of its meal production.

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7/ 9 developing countries together with 6 developed countries contributed 82 per cent of vegetable oils output in 1982 and 10 developing countries together with 5 developed countries large cake and meal producers accounted for 92 per cent of the world production.

S.2. The consumption and production outlook

In the developed countries, where per capita consumption is already nearing saturation levels, no large increases in overall consumption are likely unless new end-uses are developed. Thus, in these countries the consumption is projected to increase at an annual rate of 1.3 per cent until 1990 and thereafter it will slow down to only 1.1 per annum, until the year 2000. In the developing countries, however, present per capita consumption levels are low and total consumption is therefore expected to increase together with growing incomes and populations: annual growth rate of 3.6 per cent until 1990 and 3.4 per cent until the year 2000 are projected. For the world as a whole, the consumption is expected to grow at an annual rate of 2.7 per cent until the end of the century. The projected consumption levels are based upon expected increases in populations and incomes, taking into account historical relationships between consumption and income, and an approximate saturation level of 30 kg per capita (see tables 4.5, 4.6 and Figure 4.1).8/ The possible emergence of major substitutes for vegetable oils and fats has not been included in the projections.

Trade has grown faster than production and this trend is expected to continue. In 1982, 24 per cent of total vegetable oils production was traded. The World Bank estimates that this proportion will increase to 29 per cent in 1985 and to 31 per cent in 1995.9/ The trade in industrially processed products is increasing at the expense of unprocessed seeds. The trade of palm oil and soya bean oil between developing countries is expected to increase with Malaysia, Brazil, Argentina and Paraguay as the main exporters. Both oils are favoured imports into the solid fat markets and both are expected to maintain relatively cheap prices. Imports of meals

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8/ These growth rates are marginally lower than those estimated earlier by the World Bank and by UNIDO secretariat but coincide with recent appraisals by the trade, see J.E. Heilman "A Look at the Future", Journal of American Oil Chemists' Society, Vol. 60, No. 2, February 1983, pp. 248-250.

9/ Price Prospects for Major Primary Commodities, Vol. II, Food Products and Fertilizers, The World Bank, report Nr. 814/82, July 1982; restricted distribution.

traditionally have been concentrated in the developed countries, with the EEC playing an important role and with a small share of the developing countries (12 per cent in 1982). The share is projected to increase to 30 per cent in 1995, due mainly to large livestock developments in the CPE and in the developing countries and a predicted stagnant import market in the EEC.[10/] To further increase the global trade in the vegetable fats and oils sector, more emphasis has to be placed on removing tariffs both in developing and developed countries, and on non-tariff trade barriers in all countries.

To meet the growing demand, the total oil production in the developing countries is expected to grow by some 60 per cent between 1980 and 1995.[11/] But, given the present gross utilization crushing capacity, no new major investments in crushing facilities would be required except for, possibly, in Malaysia, Indonesia and the Philippines where the expected production growth is larger than the present underutilization. Brazil is a question mark more than the others because of present government policies which are not conducive to increased domestic production of seeds although they do favour domestic crushing over exports of seeds. Additional investments in refining capacity, however, are likely given the tendency in the developing countries towards increasing imports of crude oils.

S.3. Seizing the opportunities

For the potential expansion of the sector to be realized with an adequate contribution from the developing countries, a number of constraints will have to be overcome. The discussion that follows places special emphasis on constraints affecting the development of the industry in developing countries

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10/ The main potential competitor for vegetable oil cakes and meals is single cell protein (SCP) derived from petroleum. There are several plants installed in the world but competition is not expected to be serious before the end of the present decade, unless its price falls significantly before that time. Ibid.

11/ Ibid., annex table 2.

and it is organized along the components of the vegetable oils and fats system, from the supply of raw materials to processing, marketing and consumption, indicating the solutions that have been applied, the degree of success attained or possible solutions still to be tested. Additional solutions needed for already identified constraints are also indicated.

In the industrialized countries, economic constraints are mainly related to the expansion of markets both at the national and international level and technical constraints refer to product development and innovation in processing technology. But in the developing countries, the constraints concern one or several individual components of the vegetable oils and fats production/consumption system or their linkages. Some of these constraints require specific technical or economic solutions that could be inserted into the system. Other problems may require solutions of a different character, i.e. the application of new planning, programming and administrative approaches and techniques.

Raw material supply

Indadequate raw material supply due to competition from other crops such as cereals (which usually have a first priority in agricultural planning) or to a generalized scarcity of resources and infrastructure constitute constraints in the vegetable fats and oils sector. Competition for arable land is dominant in Asia, but not so critical in Africa and Latin America. Scarcity of infrastructure and of the necessary capital for land improvement, for research and development and training are critical restrictions on the supply of raw materials in the sector. These are restrictions that usually require large investments, accessible through international loans and joint ventures with transnational companies or through organized co-operative efforts. The successful application of such solutions is illustrated in the examples of India in safflower and rapeseed, Indonesia and Malaysia in oil palm and Brazil in soya beans (see chapter 8).

The role of the price mechanism in bringing out an adequate supply of raw materials must not be forgotten or ignored Quite simply, if the price the

growers receive for their oil-bearing materials is not attractive, the flow of raw material supply will suffer. This applies equally to government support prices and to market prices offered by the crushing industry. Quite often in developing countries, the industry pleads (with the government) that it cannot afford to pay higher prices for its raw material. But often, the roots for this situation are to be found in the low efficiency and large underutilization of capacity in the industry itself rather than in high prices for raw materials. Thus, the industry needs to look to itself for solutions rather than to the growers or the government.

The most important technical constraint is the need for higher yielding and decease resistant varieties suitable to local conditions. Advances in breeding work, analogous to those obtained in cereals that led to the "green revolution", have been made in the world's major oilseeds, for example the innovations made in rapeseed and sunflower eliminating the erusic acid and glucosinolates in rapeseed and thus increasing its acceptability as feed and food sources (see chapter 7). Moreover, cloning of oil palms is now approaching commerical exploitation and similar successes are expected in coconut. The application of genetic engineering, which is just starting, could produce unimagined innovations modifying fatty acid compostion and protein quality of oil bearing materials. However, with the exception of palm oil and coconut, in which the transfer of the technology has taken a relatively short time in South-East Asia within integrated systems of production, new technologies frequently do not diffuse smoothly and swiftly to small holders in developing countries because of a lack of both information and incentives. It is important to realize that new technology can come from developing as well as developed countries. An illustrative example is provided by the regional co-operation in the transfer of oil palm technology between Malaysia, India, Thailand and the Philippines.[12/]

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12/ Report on the First Session of the Regional Consultative Forum on the Vegetable Oils and Fats Industry for Asia and the Pacific, UNIDO/P.C.4, April 16, 1981.

Linkages between production and processing

The guaranteed and continuous supply of raw materials is one of the dominant factors in the successful operation of a vegetable oils and fats industry. Poor linkages between industry and the producers of raw materials result in decreases in both qualities and quantities and further to underutilization of the industry. This is an important constraint to the development of the industry. The causes of this disruption lie in the failure to bring the producers of raw materials into the economic circuit in which industry operates. Sufficient price and market incentives are required in order to guarantee a continuous and secure supply of quality raw materials to the industry. Improvement of this linkage has been attained by different approaches in the large oil producing countries through the application of horizontal and vertical integrated development, either through the action of multinational corporations or through public integration as in Brazil, Malaysia and the Philippines (see chapter 8).

In oil deficit countries, linkages are more difficult to attain since in these countries' production is often fragmented into small-scale farmers and oilseed processors. However, there are some successful cases in which the linkage has been promoted, either by connecting domestic production ot processing through co-operative enterprises, as in India, or by connecting seed imports with processing, as in Bangladesh.

Industrial processing

Technical factors affecting processing of oil-bearing materials in developing countries differ with the level of development of the sector in a given country or a given region. In the past there were constraints to expand the markets of palm oil and palm oil products due to the specific characteristic of the oil and to the specific requirements for handling the fruit. Solutions to these problems have come as a result of extensive research done since the beginning of the seventies by Malaysians in specialized research institutes, dedicated entirely to the question of palm oil and palm oil products. Innovations introduced which have had an important impact on the developing industry and on the international markets, are

related to better handling procedures for both fruit and oil, avoiding contamination and allowing exports in large tankers of refined oils to international markets. The introduction of efficient, versatile and fully automated fractionation units, specifically developed for palm oil, has improved greatly the penetration of palm oil products on the world markets for cooking oil and solid cooking fat.

A continuous on-going programme of reasearch undertaken by equipment manufacturers in developed countries has made important contributions to the oilseed and oil processing over the past decade. Examples are innovations in the soya bean processing that are energy saving and include improved solvent extraction designs. Physical refining of soft oils is another interesting innovation introduced recently. The transfer of these technologies is not generally considered a constraint, but their efficient application, although successful in many of the large oil producing countries, can be hampered by lack of trained personnel or by poor managing and maintenance systems often prevailing in countries with low industrial infrastructure.

In oil deficit countries where small-scale and dispersed growers dominate, the lack of efficient small-scale crushing equipment is still a technical constraint. Systematic development work for specific crops should be promoted in this field. In the coconut oil extraction process, dehusking of the nut is the highest cost component. Extensive research performed sofar to develop mechanized systems to improve efficiency of the operation has not been successful.

Supporting policies

In the past, the lack of policies to promote the development of the vegetable oils and fats sector in the developing countries has been cited as one of the major constraints on its expansion on internal and external markets, specially with regard to promoting downstream processing.[13/] In

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13/ Draft World-wide Study on the Vegetable Oils and Fats Industry, 1975-2000, UNIDO/ICIS.46, September 1977.

the past few years, however, there has been an important tendency among governments of developing countries that are large producers of oilseeds and oils, to promote the exports of industrial products instead of raw materials. To that effect, industrial investment and fiscal policies among others have been implemented. In the past, palm kernels and copra were not processed locally in the Philippines and palm oil was exported crude from Malaysia. Today, 90 per cent of oil palm exports from Malaysia are refined and/or fractionated and the Philippines exports mostly oil instead of copra. In Brazil, industrial promotion has been heavily export oriented and has produced a very large industrial capacity expansion and large exports of soya bean oil and meal.

The present large underutilization of crushing capacities in the developing countries should be viewed as a constraint to the development of the sector and as a sign of poor industrial planning, specially in large oil producing countries in which the constraints related to securing raw materials have been overcome. Thus existing policies and programmes must be constantly monitored to assure that they are leading to the desired results rather than developing into actual constraints and they should be adapted to changing market situations. The present situation raises the question concerning promotional development policies both at the national and at the international level: Are they really promoting industrialization or just the purchase of equipment?

Multiple factors affect the level of capacity utilization at the crushing stage, difficulties in securing continuous supply of raw materials, the competition of human consumption with industrial consumption of oilseeds, the capacity to import crude oils instead of seed depending on the situation of the international market and the domestic demand for oilcake in Africa, Asia and Latin America. All these factors arise from the complexity of this sector and point to the need for an adequate flow of information on the different components and on the marketing at all levels to be able to monitor effectively the development policies.

Marketing agreements and joint ventures

Marketing constraints are of internal and external character and affect different components and linkages in the vegetable oils and fats system. Complete dependence on internal or external markets add to the vulnerability of the raw material producers and of the processors.

The expansion of markets is not only limited by strong competition among the developed and the developing countries, but by tight specifications existing in importing countries that are often difficult to meet. The scarcity or lack of joint ventures between exporters and importers are also limiting the potential markets. There are now, however, signs of new joint ventures designed to help to overcome these constraints. For example, there is the case of a Brazilian soya bean co-operative crushing seeds in Iran, a main importer, an industrial enterprise set up in Malaysia jointly by Japan and Malaysia, and the recent establishment of a Malaysian plant in England in order to meet the tight specifications set up by the food industry in this country.

A constraint to increasing South-South trade in oils and oil products is the limited amount of long-term purchase agreements among developing countries. Importers often do not make realistic assessments of their import needs within their self-sufficiency programming and are then required to purchase on the spot market under concessional terms. However, advances have taken place in the last few years with some good examples of purchase agreements made between developing countries such as Argentina and Cuba for the years 1982 and 1985 for soya bean meal, Brazil and Iran in 1982 for soya beans and cooking oils, and in 1983 between Malaysia and China for palm oil.

A constraint to the development of the sector lies in the vulnerability of local producers of raw materials and industrial products to the effects of fluctuating international prices and to artifically fixed low internal prices, offered by the local oil mills or set by the government. A solution to this constraint has been found in a diversified market portfolio consisting of both internal and international markets. This is the case of Papua New Guinea, a

country that divides its external market between Japan and the EEC and leaves a share of its production for the local market; of Malaysia that divides its external market between Asia and the European Economic Community.

At the international level, the slow expansion of oils consumption in developed countries has intensified the competition between industrialized and developing countries for the limited markets. This together with increased expansion of installed industrial capacity in the developing countries has led to an imbalance in demand versus supply that produce falling and/or fluctuating prices in the international market. Thus, the possibility of establishing an international agreement to stabilize the sector was discussed at several times since 1970 but without success. In the absence of such international agreement, as originally proposed, guidelines for international co-operation in the oils, oilseeds and oilmeals sector were designed and adopted in 1980 by the FAO Inter-governmental Group on Oilseeds, Oils and Fats.[14/] These guidelines intend to promote co-operation in the oilseeds, oils and oilmeals sector through the harmonization of national policies in order to attain an expansion in production that is in balance with domestic consumption and trade. One of the specific objectives of the guidelines aims at enabling developing countries to develop more fully their production and processing potentials and to promote their greater contribution to growing world supplies, consumption and trade. A monitoring of the application of the guidelines is performed yearly by the group and specific recommendations are given to both producers and consumers during the committee's regular sessions. For these reasons, the guidelines should be viewed by the developing countries as an important advancement towards international co-operation and as a frame of reference for discussing and reviewing national policies that affect the world development of this sector. The results of the latest review[15/] indicate that there have been some positive advances towards achieving the objectives on rationalization of support prices,

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14/ Guidelines for International Co-operation in the Oilseeds, Oils and Meals Sector, annex, in: Follow-up to the Guidelines for International Co-operation in the Oilseeds, Oils and Oilmeals Sector, FAO, CCP: OF 84/5, January 1984.

15/ Ibid.

progressive reduction of tariff and non-tariff barriers to trade and contract agreements, but that there is still large room for improvements to be made and constraints to be overcome in relation to production, trade, food aid, and stocking policies.16/

Integrated development

The above discussion indicates that developing countries have made important progress in overcoming many constraints to the development of the sector. It also indicates that South-South co-operation has proved to be successful in solving some of them and that different integrated development approaches are being applied with some success both in oil deficit and surplus countries. However, underlying most of the constraints is the lack of a comprehensive integrated approach to sector planning of the vegetable oils and fats industries in the developing countries. The large number of industrial components involved, the numerous oil-bearing materials and their associated products, the technical substitutability of oils and the strong linkages to external markets, both in raw materials and in finished products, point to the need for designing and applying interrelated policies to regulate the operation of the sector in a systematic way. This should be possible by applying an integrated approach to the planning of the sector as described in this report. The application of this planning concept together with the use of appropriate tools for simulating alternative options for development will enable governments and industrialists to refine decision-making by considering simultaneously the consumption, production, industrialization and trade components, both in oil surplus and deficit countries. This approach should be applied to the identification of the potential for the integrated development of the oilseed sector on an individual country basis, in particular in developing countries that are currently net importers and have low levels of per capita consumption.

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16/ Since the overall progress made in the last year was considerably less than in the two previous years, Ibid.

# 1. GENERAL OVERVIEW

## 1.1 The role of the vegetable oils and fats industries within the food industry and the manufacturing sector

The vegetable oils and fats industry is one of the branches of the food processing industries. Although its activities are also linked with the chemical industries, the primary use of vegetable oils and fats are closely related to man's need of food. The purpose of this chapter is to place the vegetable oils and fats industry within the food processing industry and to briefly describe some of the characteristics that are specific to this sub-sector which will influence the discussion in later chapters of the report.

In 1980 the food industries[17/] accounted for 13 per cent of total manufacturing value added in developing countries and for 9 per cent in both the centrally planned economies and the developed market economies.[18/] Although the relative importance of these industries has declined in all economic groupings since 1963, food processing remains among the largest industrial branches in the manufacturing sector.

In the developing countries the food industries generate more value added than any other branch of manufacturing. Moreover, even while loosing ground within the manufacturing sector, the food processing industries in the developing countries have still grown at a higher average rate (4.6 per cent per year from 1973 to 1980) than in the centrally planned economies and developed market economies (3.2 and 2.7 per cent, respectively), with the result that the developing countries' share of world manufacturing value added derived from food processing has increased, at least through 1981 (the latest year for which data are available) (see table 1.1).

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17/ Defined as branch 311/2 of the International Standard Industrial Classification (ISIC) which includes vegetable oil and fat production.

18/ A Statistical Review of the World Industrial Situation, 1983, UNIDO/IS.433, March 1984, p. 13.

Table 1.1. Share of economic groupings in value added originating in the food processing industries,[a] at constant 1975 prices and selected years, (percentage)

| Economic grouping[b] | 1970 | 1975 | 1981 |
|---|---|---|---|
| Developing countries | 13.7 | 13.8 | 15.4 |
| Centrally planned economies | 25.4 | 27.8 | 26.1 |
| Developed market economies | 60.9 | 58.4 | 58.5 |
| Total | 100.0 | 100.0 | 100.0 |

a/ For a definition of food processing industries, see footnote 17

b/ Excluding the People's Republic of China because of non-reporting.

Source: A Statistical Review of the World Industrial Situation, 1983, UNIDO/IS.433, March 1984, p. 10.

The share of developing countries in the quantity of selected processed foods produced world-wide for 1971 and 1980 is shown in table 1.2. It can be seen that, among the eight selected food products (excluding vegetable oils) shown on the upper part of the table, the relative contribution of developing countries is generally low except for sugar and refineries, where the physical output of developing countries constitutes 40 per cent of the world total. No other non-oil food product approaches this figure. The shares for grain mill products, meat and fish preparations, and for dairy products might be described as intermediate on the list. Considering the large contribution of developing countries to the world's refined sugar output, it is interesting that the developing countries' participation downstream, i.e. with respect to the canning and preserving of fruits and vegetables and to the manufacture of cocoa, chocolate and sugar confections, is very low. Production of prepared animal feeds is also low, but this is not surprising because of both the small size of poultry industries and the practice of grazing livestock in most developing countries.

The picture for vegetable oils and fats is dramatically different. Among crude oils (lower panel of table 1.2), and excepting soya beans,[19/] the developing countries' share of world production is relatively high, accounting for from one-half to more than 90 per cent of the total.

Later chapters of this report discuss many problems and constraints attached to the further development of the vegetable oils and fats industries in the developing world. Nevertheless, the available information suggests that the vegetable oils and fats industry occupies a relatively important position within the food processing industries of developing countries. Developing countries have already become important world producers of many vegetable fats and oils, and there is reason to believe that they can make additional gains towards achieving their maximum potential, given favourable conditions.

## 1.2 Main features of the vegetable oils and fats industry

The vegetable oils and fats industry is characterized by:

(a) Well-defined primary inputs;

(b) Linkages of some outputs (especially meals) to other food and agricultural industries;

(c) The interchangeability of intermediate products (especially crude oils) at further processing stages; and

(d) Widespread use of modern technologies, with resultant international competitiveness of some individual developing countries.

These factors and their implications for the development of the vegetable oils and fats industry in the developing world are briefly described in the following sections.

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19/ Soya beans represents a special case, because its production and processing are still concentrated in the developed countries.

Table 1.2. World and developing countries production of selected processed foodstuffs shares and growth rates, 1971 and 1980 (thousand metric tons)

| Product (ISIC) | World production | | Developing countries production | | Share of developing countries % | | Annual growth rate 1971-1980 | |
|---|---|---|---|---|---|---|---|---|
| | 1971 | 1980 | 1971 | 1980 | 1971 | 1980 | World production | Developing countries |
| Slaughtering, preparing and preserving meat (3111) | 113,389 | 146,912 | 21,168 | 27,649 | 18.7 | 18.8 | 2.9 | 3.0 |
| Dairy products (3112) | 21,246 | 27,388 | 3,441 | 4,612 | 16.2 | 16.8 | 2.9 | 3.3 |
| Canning and preserving of fruits and vegetables (3113) | 17,757 | 19,978 | 1,213 | 1,286 | 6.8 | 6.4 | 1.3 | 0.7 |
| Canning, preserving and processing of fish (3114) | 13,699 | 15,957 | 2,080 | 2,438 | 15.2 | 15.6 | 1.7 | 1.8 |
| Grain mill products (3116) and bakery products (3117) | 198,098 | 226,768 | 29,525 | 45,702 | 14.9 | 20.2 | 1.5 | 5.0 |
| Sugar and refineries (3118) | 119,097 | 137,371 | 47,612 | 58,212 | 40.0 | 42.4 | 1.6 | 2.3 |
| Cocoa, chocolate and sugar confectionery (3119) | 9,428 | 10,659 | 640 | 761 | 6.8 | 7.1 | 1.4 | 2.0 |
| Prepared animal feeds (3122) | 122,178 | 192,688 | 8,352 | 16,449 | 6.8 | 8.5 | 5.2 | 7.8 |
| Crude vegetable oils - TOTAL | 19,767 | 30,134 | 9,100 | 14,522 | 46.0 | 48.2 | 4.8 | 5.3 |
| Oil-soyabean, crude (311510) | 6,352 | 12,308 | 851 | 3,373 | 13.4 | 27.4 | 7.6 | 16.5 |
| Oil-cottonseed, crude (311516) | 2,526 | 2,957 | 1,294 | 1,448 | 51.2 | 49.0 | 1.8 | 1.3 |
| Oil-groundnut, crude (311522) | 3,100 | 2,439 | 2,818 | 2,296 | 90.9 | 94.1 | -2.6 | -2.3 |
| Oils-others, crude (311534) | 7,789 | 12,430 | 4,137 | 7,405 | 53.1 | 59.6 | 5.3 | 6.7 |

Source: UN Yearbook of Industrial Statistics, Vol. II, 1980 Edition, United Nations, New York, 1982; and UN Yearbook of Industrial Statistics, 1981 Edition, Vol. II, United Nations, New York, 1983.

### 1.2.1 Inputs

There are ten edible oil crops of commercial value in the world market, seven of which are seed crops (cottonseed, groundnuts, rapeseed, safflower seed, sesame seed, soya beans and sunflower seed), and three are tree crops (coconut, olives and oil palm/kernels). Cultivation of several of these crops (coconut with copra, and oil palm/palm kernels) is limited almost exclusively to developing countries, where the most favourable climatic and soil conditions are found. However, some are annual crops and some are perennial (tree) crops, and these have very different possibilities to respond to changes in the world market.

### 1.2.2 Linkages

With the exception of palm oil, which has no associated oilmeals, each oilcrop is capable of being converted into varying proportions of vegetable oil and meal, raw materials that are the starting point for the establishment of a chain of economically linked industries as it was picture in figure S.2. Moreover, cakes and meals constitute basic raw materials for modern livestock feeding techniques linked with the meat and poultry industry as illustrated by figures S.1. and S.2. Because of the relatively high protein content and relatively low cost of the flour,[20/] there has also been a sustained interest in increasing their utilization as a dietary protein source for humans.[21/]

### 1.2.3 Interchangeability of intermediate products

Crude oils and fats are interchangeable as inputs for most downstream uses, and therefore demand for a particular oil can be quite unstable. This introduces uncertainty for suppliers, while making growers of perennial crops

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20/ A by-product of seed crushing designed for human consumption.

21/ The use of oilseed protein has been the subject of much research directed towards the provision of an adequate protein content in the diets of children of developing countries.

especially vulnerable. Close substitutability of crude oils also suggests that traditional price gaps on the world market should be closing, and it is possible that prices could settle at a level that makes production and processing of some oil crops uneconomical. (See appendix 1). Indeed, this may be a contributing factor in the diminishing production of groundnuts observed in recent years.

### 1.2.4 Technologies

The growth of food industries in the developing countries has been strongly influenced by the transfer of modern technologies from the developed countries, and the vegetable oils and fats industry in the developing countries has been a major recipient of such technology transfer (partly because of the close involvement of transnational corporations in this area of food processing). Indeed, among the developing countries, the processing activities of some large producers of oil crops are so highly developed and productive in their technologies that they now share a common interest with developed countries in resisting the protective measures of net oil importers. For example, Brazil and Malaysia (among others) have joined with the United States in opposing the proposed new taxes on imported oils that are under consideration within the EEC.

Although, some of the above characteristics are not unique to the vegetable oils and fats industry, they are important and must be taken into account in considering the prospects for growth and development of this area of industrial activity.

## 2. THE WORLD OUTPUT OF VEGETABLE OILS AND FATS AND THE POSITION OF DEVELOPING COUNTRIES

### 2.1 Global overview

The world's oilcrop economy (annual and perennial crops) continues to grow at a comparatively rapid rate. Global production of oilseeds has shown a substantial increase from 130.6 million tons in 1976 to 179.7 million tons in 1982, an increase of 37.6 per cent with a yearly growth rate of 5.4 per cent. This is due mainly to the dramatic expansion of soya bean, sunflower seed and rapeseed production, as well as cottonseed. Palm kernel production has also increased rapidly but is not an important contributor to world totals in absolute terms. Oil palm production on the contrary has grown twice as fast as oilseeds and in 1982 contributed 16.1 per cent of total crushings as it would be discussed in chapter 5.

The world output of oil crops (in oil equivalents) from 1976 to 1982 is shown in table 2.1.[22/] The largest contribution (56 per cent) to the world production of vegetable oil in 1982 was made by the developing countries,[23/] followed by the developed market economies (35.8 per cent), the European centrally planned economies having contributed 8.3 per cent of the total production. The most important producing regions among the developing countries in 1982 were South and South-East Asia and Latin America. The regional distribution did not show important modifications through the period, but the growth rates did. The largest growth rates were registered by the Asian centrally planned economies, more than twice that of the world. Other areas

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22/ Crops included: copra, cottonseed, groundnuts, oil palm, palm kernels, rapeseed, soya beans and sunflower seed. Figures for olive oil, safflower and sesame seed could not be extracted separately from the data base used, but are included in this group.

23/ Developing market economies plus CPE Asia.

Table 2.1. Production of vegetable oils and fats (oil equivalent) by regions[a/]
(thousand metric tons)

| Region | 1976 Total | 1976 Share % | 1978 Total | 1978 Share % | 1980 Total | 1980 Share % | 1982 Total | 1982 Share % | Annual average growth rate 1976-82 |
|---|---|---|---|---|---|---|---|---|---|
| Developed market economies | 12,086 | 35.6 | 14,041 | 38.6 | 17,922 | 41.7 | 15,878 | 35.8 | 4.7 |
| European centrally planned economies | 3,501 | 10.3 | 3,903 | 10.7 | 3,683 | 8.6 | 3,698 | 8.3 | 0.9 |
| Developing market economies | 16,401 | 48.4 | 16,537 | 45.5 | 18,805 | 43.7 | 20,910 | 47.2 | 4.1 |
| Africa, South of Sahara | 2,808 | 8.3 | 2,511 | 6.9 | 2,693 | 6.3 | 2,843 | 6.4 | 0.2 |
| North Africa and West Asia | 1,294 | 3.8 | 1,265 | 3.5 | 1,217 | 2.8 | 1,277 | 2.9 | -0.2 |
| South and South-East Asia | 8,430 | 24.9 | 8,586 | 23.6 | 9,434 | 21.9 | 11,703 | 26.4 | 5.6 |
| Latin America | 3,869 | 11.4 | 4,175 | 11.5 | 5,461 | 12.7 | 5,087 | 11.5 | 4.7 |
| Asian centrally planned economies | 1,923 | 5.7 | 1,880 | 5.2 | 2,597 | 6.0 | 3,845 | 8.7 | 12.2 |
| World total | 33,912 | 100.0 | 36,359 | 100.0 | 43,004 | 100.0 | 44,332 | 100.0 | 4.6 |

a/ Crops included: copra, cottonseed, groundnuts, oil palm, palm kernels, rapeseed, soya beans and sunflower seed. Figures for olive oil, safflower and sesame seed could not be extracted separately from the data base used, but are included in this group.

Source: Data supplied by FAO; UNIDO secretariat calculations.

showing growth rates above the world's growth rate were South and South-East Asia, Latin America and the developed market economies. A decline was shown by North Africa and West Asia (table 2.1).

The manufacture of oilcakes represents the world's major source of industrial protein for the animal-feed industry. Here soya bean with its low oil, high cake content compared with most other oilseeds is the dominant raw material. The bulk of the remaining production is accounted for by cottonseed, groundnuts, rapeseed, sunflower seed and copra. Palm kernel, sesame seed and safflower seed are of relatively minor importance. Developing countries[24/] produced 39.5 per cent of world oilcake supplies (in actual terms in 1982) while the developed countries produced 54.5 per cent and the centrally planned economy countries 5.9 per cent (table 2.2). Although the United States is still dominant (50 per cent of the world total in 1982), Brazil has also succeeded in considerably raising its share (11 per cent of the world total in 1982) in world production (table 2.3 (b)). Thus, it is these two countries that largely influence the trends in world oilcake production.

The concentration of the production of oils and meals in a limited number of countries is illustrated in table 2.3. Of the fifteen countries which accounted for 82 per cent of the vegetable fats and oils output in 1982, eleven are developing countries; in the same year, 90 per cent of the oilmeal production was produced by only ten countries, six of which are developing countries. However, the pattern of concentration differs because of difference in the pattern of oil crops on which production is based. As a result, oil production is more broadly distributed, while only six countries in 1982 could be described as major meal producers (and only five in 1976, because Argentina's soya bean meal production was still relatively modest at that time). Although, the dominant role is played by the United States, both in oil and meal production, other important producers are Malaysia (oils only), the People's Republic of China, India, Brazil and the USSR. Brazil made an important contribution to the rapid expansion of soya beans output

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24/ Developing market economies plus Asian CPE.

Table 2.2. World production of vegetable cakes and meals[a/]
(annual averages)

| Region | 1976 | | 1978 | | 1980 | | 1982 | | Growth rate 1976-82 |
|---|---|---|---|---|---|---|---|---|---|
| | Total production | Share (per cent) | Total production | Share (per cent) | Total production | Share (per cent) | Total production | Share (per cent) | |
| Developed market economies | 16,317 | 53.8 | 19,120 | 57.3 | 24,554 | 59.2 | 21,656 | 54.5 | 4.8 |
| European centrally planned economies | 2,203 | 7.3 | 2,365 | 7.1 | 2,324 | 6.5 | 2,340 | 5.9 | 1.0 |
| Developing market economies | 9,706 | 32.0 | 9,853 | 29.5 | 12,106 | 29.2 | 12,205 | 30.7 | 3.9 |
| Africa, South of Sahara | 794 | 2.6 | 630 | 1.9 | 682 | 1.6 | 735 | 1.9 | -1.3 |
| North Africa and West Asia | 694 | 2.3 | 794 | 2.4 | 726 | 1.8 | 801 | 2.0 | 2.4 |
| South and South-East Asia | 2,959 | 9.8 | 2,813 | 8.4 | 2,795 | 6.7 | 3,484 | 8.8 | 2.8 |
| Latin America | 5,259 | 17.3 | 5,616 | 16.8 | 7,903 | 19.1 | 7,185 | 18.1 | 5.3 |
| Asian centrally planned economies | 2,097 | 6.9 | 2,026 | 6.1 | 2,464 | 5.9 | 3,502 | 8.8 | 8.9 |
| World total | 30,322 | 100.0 | 33,364 | 100.0 | 41,448 | 100.0 | 39,703 | 100.0 | 4.6 |

a/ In terms of 100 per cent protein to facilitate statistical comparison.

Source: Data supplied by FAO; oilcrops include: copra, cottonseed, groundnuts, palm kernels, rapeseed, safflower, sesame seed, soya beans and sunflower seed.

Table 2.3. 15 major producing countries in 1976 and 1982
Vegetable oils and fats (oil equivalent) a/

| Country | Production 1976 (thousand tons) | Share 1976 (per cent) |
|---|---|---|
| 1. USA | 8,476 | 25.0 |
| 2. India | 2,804 | 8.3 |
| 3. USSR | 2,445 | 7.2 |
| 4. Brazil | 2,324 | 6.8 |
| 5. China | 1,830 | 5.4 |
| 6. Malaysia | 1,662 | 4.9 |
| 7. Philippines | 1,660 | 4.9 |
| 8. Indonesia | 1,361 | 4.0 |
| 9. Nigeria | 853 | 2.5 |
| 10. Italy | 702 | 2.1 |
| 11. Spain | 689 | 2.0 |
| 12. Canada | 677 | 2.0 |
| 13. Argentina | 590 | 1.7 |
| 14. Mexico | 475 | 1.4 |
| 15. Turkey | 425 | 1.3 |
| 15 major countries | 26,973 | 79.5 |
| Other countries | 16,957 | 20.5 |
| World | 33,930 | 100.0 |

| Country | Production 1982 (thousand tons) | Share 1982 (per cent) |
|---|---|---|
| 1. USA | 11,716 | 26.4 |
| 2. Malaysia | 4,073 | 9.2 |
| 3. China | 3,683 | 8.3 |
| 4. India | 3,280 | 7.5 |
| 5. Brazil | 2,671 | 6.0 |
| 6. USSR | 2,460 | 5.5 |
| 7. Indonesia | 1,783 | 4.0 |
| 8. Argentina | 1,390 | 3.1 |
| 9. Philippines | 1,379 | 3.1 |
| 10. Nigeria | 953 | 2.1 |
| 11. Canada | 747 | 1.7 |
| 12. Italy | 710 | 1.6 |
| 13. France | 536 | 1.2 |
| 14. Spain | 492 | 1.1 |
| 15. Turkey | 451 | 1.0 |
| 15 major countries | 36,324 | 81.9 |
| Other countries | 8,020 | 18.1 |
| World | 44,344 | 100.0 |

Table 2.3. 15 major producing countries in 1976 and 1982
(b) Vegetable cakes and meals (100 per cent protein equivalent)[a/]

| Country | Production 1976 (thousand tons) | Share 1976 (per cent) |
|---|---|---|
| 1. USA | 15,143 | 49.9 |
| 2. Brazil | 3,923 | 12.9 |
| 3. India | 2,165 | 7.1 |
| 4. China | 2,013 | 6.6 |
| 5. USSR | 1,633 | 5.4 |
| 6. Argentina | 591 | 1.9 |
| 7. Canada | 502 | 1.7 |
| 8. Mexico | 386 | 1.3 |
| 9. Turkey | 234 | 0.8 |
| 10. Senegal | 231 | 0.8 |
| 11. Pakistan | 213 | 0.7 |
| 12. Sudan | 203 | 0.7 |
| 13. Romania | 187 | 0.6 |
| 14. Philippines | 187 | 0.6 |
| 15. Poland | 139 | 0.5 |
| 15 major countries | 27,750 | 91.5 |
| Other countries | 2,590 | 8.5 |
| World | 30,340 | 100.0 |

| Country | Production 1982 (thousand tons) | Share 1982 (per cent) |
|---|---|---|
| 1. USA | 20,032 | 50.5 |
| 2. Brazil | 4,520 | 11.4 |
| 3. China | 3,416 | 8.6 |
| 4. India | 2,533 | 6.4 |
| 5. Argentina | 1,826 | 4.6 |
| 6. USSR | 1,700 | 4.3 |
| 7. Canada | 588 | 1.5 |
| 8. Mexico | 406 | 1.0 |
| 9. Pakistan | 281 | 0.7 |
| 10. France | 270 | 0.7 |
| 11. Turkey | 255 | 0.6 |
| 12. Sudan | 249 | 0.6 |
| 13. Paraguay | 225 | 0.6 |
| 14. Romania | 215 | 0.5 |
| 15. Egypt | 176 | 0.4 |
| 15 major countries | 36,692 | 92.4 |
| Other countries | 3,020 | 7.6 |
| World | 39,712 | 100.0 |

a/ In terms of 100 per cent protein equivalent to facilitate statistical comparisons. Crops included: copra, cottonseed, groundnuts, oil palm, palm kernels, rapeseed, soya beans and sunflower seed. Figures for olive oil, safflower and sesame seed could not be extracted separately from the data base used, but are included in this group.

Source: Data supplied by FAO; UNIDO secretariat calculations.

witnessed in the past decade, an increase from 1969-1971 to 1981 by about 102 per cent, or 39.5 per cent in the period 1976-1981. Thus, production of soya beans in Brazil rose 10 times from only 1.5 million tons in 1969-1971 to almost 13 million tons in 1982. Brazil's increased output contributed decisively to the enlarged developing countries' share in world production of soya beans.

These shifts amounted to an improvement in the relative situation of Latin America whose share rose from 9 per cent of world output in 1970 to around 11 per cent in 1976 and 1982 and a deterioration in the position of Africa whose regional share in world output fell from 11 per cent in 1970 to 6 per cent in 1982.

The dominance of soya bean oil is also challenged by the expansion of the palm oil industry in Malaysia, which now contributes more than 10 per cent to the world's edible oil market.

At this point it is worth noting the advantages that oil palm presents for countries with an adequate tropical environment over annual crops: it is a perennial crop; it starts producing after five years of planting; for the following 30 to 35 years and it is capable of producing 9 times more oil per unit area than soya beans, 4 times more than groundnuts and 18 times more than cottonseed.[25/] These facts, together with the technological advances made in increasing the applicability of the oil, explain the growing importance of palm oil in the world vegetable oil market.

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25/ J. Mason and L. Ginar, "Palm oil production keeps pace with world demand", Food Engineering International, June 1980; H.B.W. Patterson, UNIDO consultant, "Measures and forms to promote integrated development of the vegetable oils and fats industry", internal report, October 1983.

## 2.2 Contribution of the developing countries[26/]

Table 2.4 and figure 2.1 show the level of production of different oilseeds and the share of developing countries during selected years within the period under consideration. As can be seen, developing countries are the sole commercial producers of palm kernels and copra, and virtually the sole producers of sesame seed and groundnuts, although palm kernels are the only crop to have grown significantly between 1976 and 1982. However, developing countries have also become increasingly dominant in the production of safflower seed, and, to a lesser extent, cottonseed. By 1982, rapeseed production in the developing countries had grown to the point where they had become the major rapeseed source. Moreover, even though their share of world sunflower production is still small, the developing countries have made greater gains in sunflower seed production than the rest of the world during this period.

The only seed crop for which developing countries have lost their relative position among world producers is soya beans. Even so, production of soya beans among developing countries in 1982 was 47 per cent above 1976 levels, their share in the world production decreased from 42 per cent to 30 per cent. Volumewise, there are only three oilseeds in which the contribution of developing countries to the world production is really significant: soya beans, groundnuts and cottonseed. On the other hand, palm oil, which is produced 100 per cent in the developing countries, largely contributes to the world's vegetable oil economy, 14 per cent of world crushings in 1982.[27/] Palm oil recorded one of the highest increases in the production of oils, its total output rose by 170 per cent between 1969-1971 and 1981, with an annual growth rate of 10.3 per cent between 1976 and 1982. This extremely rapid growth is due mainly to the expansion of palm oil output in Malaysia, which accounted for only 23 per cent in 1969-1971 but grew to 52 per cent of total supply in 1982.

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26/ Developing market economies plus Asian centrally planned economies. Oil palm fruits are not included.

27/ See chapter 5, table 5.1.

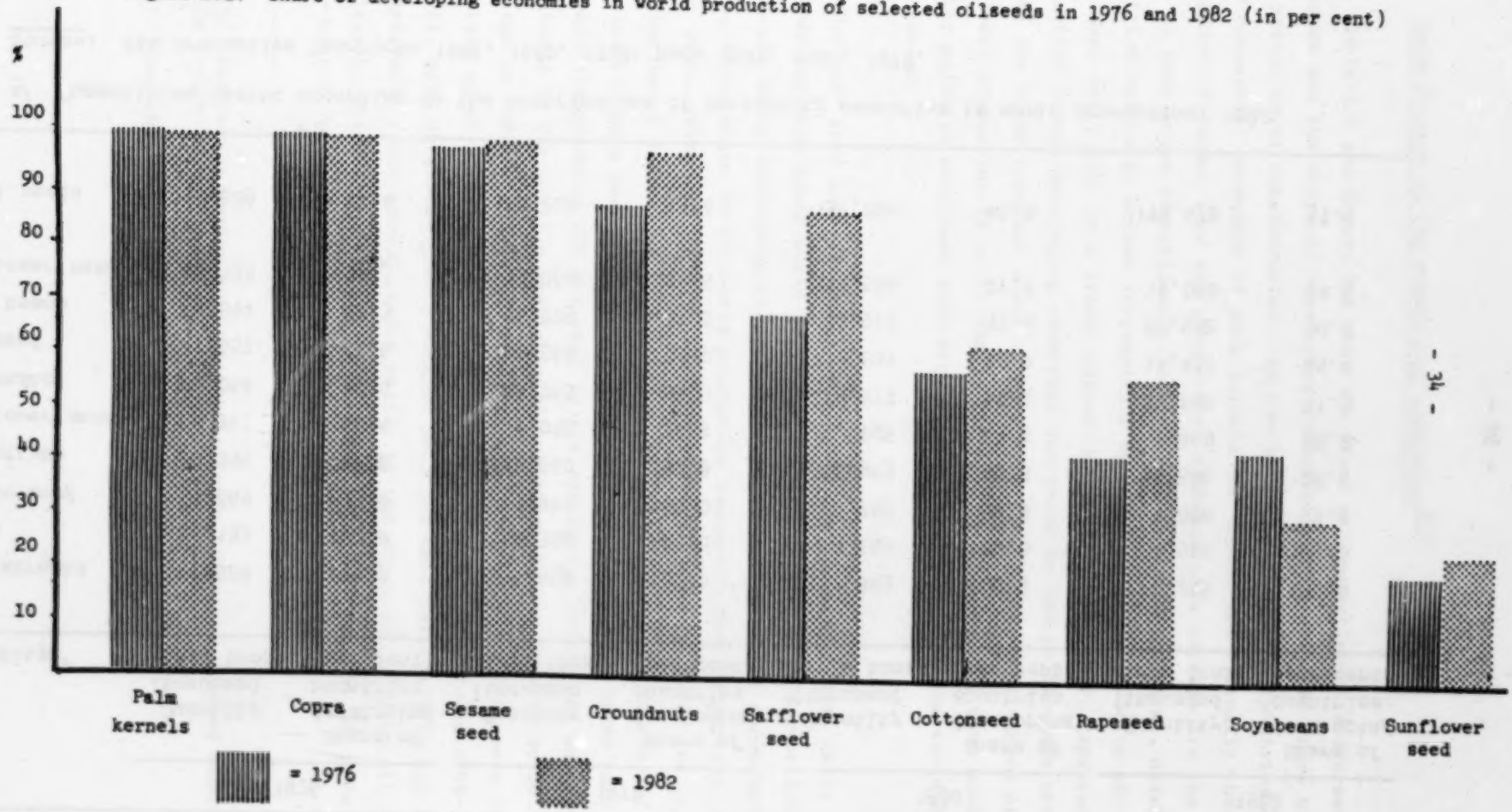
Table 2.4. World production of selected oilseeds

| Commodity[a/] | 1976 | | 1978 | | 1980 | | 1982 | |
|---|---|---|---|---|---|---|---|---|
| | Quantity (thousand metric tons) | Share of developing countries (per cent) | Quantity (thousand metric tons) | Share of developing countries (per cent) | Quantity (thousand metric tons) | Share of developing countries (per cent) | Quantity (thousand metric tons) | Share of developing countries (per cent) |
| Palm kernels | 1,524 | 100.0 | 1,459 | 100.0 | 1,843 | 100.0 | 2,266 | 100.0 |
| Copra | 5,133 | 100.0 | 4,392 | 100.0 | 4,663 | 100.0 | 4,906 | 100.0 |
| Sesame seed | 1,869 | 99.8 | 1,941 | 100.0 | 1,762 | 99.8 | 1,870 | 99.9 |
| Groundnuts | 17,895 | 88.8 | 18,660 | 87.8 | 16,965 | 90.8 | 18,580 | 98.5 |
| Safflower seed | 747 | 68.4 | 1,085 | 76.9 | 896 | 84.5 | 859 | 85.2 |
| Cottonseed | 22,664 | 57.6 | 24,765 | 59.5 | 26,579 | 59.2 | 27,692 | 61.3 |
| Rapeseed | 7,557 | 41.6 | 10,568 | 37.9 | 10,601 | 40.9 | 14,472 | 55.4 |
| Soya beans | 63,064 | 42.3 | 76,723 | 31.2 | 80,910 | 37.0 | 92,982 | 30.7 |
| Sunflower seed | 10,136 | 19.3 | 13,069 | 20.4 | 13,586 | 27.2 | 16,046 | 24.6 |
| Total seeds | 130,589 | 53.4 | 152,662 | 43.6 | 157,805 | 49.5 | 179,673 | 47.6 |

a/ Commodities listed according to the contribution of developing countries to world production, 1982.

Source: FAO Production Yearbooks 1982, 1980, 1978; Rome 1983, 1981, 1979.

Figure 2.1. Share of developing economies in world production of selected oilseeds in 1976 and 1982 (in per cent)




Source: Table 2.4.

Within the developing countries, the concentration of production in a limited number of countries is illustrated in table 2.5, in which countries are divided into two groups. The first group contains 9 of the largest producer-exporting countries and the second group shows all the remaining developing oil-producing countries. The People's Republic of China is shown separately. As it can be observed, the output of the first group grew during the period at an annual rate four times as large as that of the second group. Within the latter, negative growth rates are registered for Africa and the Near East. The People's Republic of China, indicates an impressive rate of growth, similar to that of countries with a fast growing oil production, such as Malaysia, Argentina and Paraguay. The increase in production in the nine-country group has been mainly in soya bean oil in South America, palm oil in Asia and the Pacific with less important increases in coconut in Asia and the Pacific and in groundnuts in Africa and the Near East. The expansion has frequently come from increases in area more than increases in yield. In the case of oil palm, for which high yielding and decease resistant varieties have been developed high increases in yield have concentrated in Malaysia. Large investments and integrated systems of production processing and marketing have also been applied.28/

A closer look at 13 countries belonging to the second group of vegetable oils and fats producers of table 2.5, which are also important oils and fats importers,29/ is given in table 2.6. Among these countries, further concentration of production is observed; India contributed to the total production of the group with 60 per cent, Nigeria with 20 per cent and four other countries with 17 per cent. In these countries annual rates of growth during the period ranged between 1.4 per cent for Mexico and 5.9 per cent for Colombia. The rest (8 countries) constitutes a group of very small producers

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28/ Hancock, F. Richard, "The changing role of developing countries in the world economy of fats and oils; effects on the EEC", in: Chemistry Industry, 3 July 1982, pp. 439-442.

29/ That together import more than 70 per cent of oil imports of all developing countries.

Table 2.5. Vegetable oils and fats production: by regions and major exporting developing countries (thousand metric tons)

| | 1976 | 1978 | 1980 | 1982 | Annual Growth rate 1976-1982 |
|---|---|---|---|---|---|
| World | 33,930 | 36,374 | 43,018 | 44,344 | 4.6 |
| All developed | 15,588 | 17,942 | 21,602 | 19,577 | 3.9 |
| All developing | 18,342 | 18,432 | 21,416 | 24,767 | 5.1 |
| Nine major developing exporters - Total | 8,307 | 8,911 | 10,940 | 12,241 | 6.7 |
| Africa | | | | | |
| Ivory Coast | 194 | 195 | 245 | 237 | 3.4 |
| Latin America | | | | | |
| Argentina | 590 | 1,091 | 1,243 | 1,390 | 15.4 |
| Brazil | 2,324 | 2,045 | 3,044 | 2,671 | 2.3 |
| Paraguay | 68 | 88 | 121 | 136 | 12.2 |
| Near East | | | | | |
| Sudan | 334 | 380 | 307 | 394 | 2.8 |
| Asia and Pacific | | | | | |
| Indonesia | 1,361 | 1,388 | 1,662 | 1,783 | 4.6 |
| Malaysia | 1,662 | 2,085 | 2,974 | 4,073 | 16.1 |
| Papua New Guinea | 114 | 125 | 132 | 178 | 7.7 |
| Philippines | 1,660 | 1,514 | 1,212 | 1,379 | -3.0 |
| China | 1,830 | 1,755 | 2,456 | 3,683 | 12.4 |
| Other developing countries - Total | 8,205 | 7,766 | 8,020 | 8,843 | 1.3 |
| Africa | 2,614 | 2,316 | 2,448 | 2,606 | -0.1 |
| Latin America | 887 | 951 | 1,053 | 890 | 0.1 |
| Near East | 960 | 885 | 910 | 883 | -1.4 |
| Asia and Pacific | 3,744 | 3,614 | 3,609 | 4,464 | 3.0 |

Oilcrops included: copra, cottonseed, groundnuts, oil palm, palm kernels, rapeseed, soya beans and sunflower seed. Figures for olive oil, safflower and sesame seed could not be extracted separately from the data base used, but are included in this group.

Source: Data supplied by FAO; UNIDO secretariat calculations.

Table 2.6. Total vegetable oils and fats production in main importing developing countries[a/]
(thousand metric tons)

| Countries | 1976 | 1980 | 1982 | Annual Growth rate 1976-1982 |
|---|---|---|---|---|
| India | 2,521 | 2,229 | 2,897 | 2.3 |
| Nigeria | 853 | 919 | 953 | 1.9 |
| Mexico | 259 | 297 | 282 | 1.4 |
| Pakistan | 220 | 264 | 269 | 3.4 |
| Egypt | 97 | 122 | 133 | 5.4 |
| Colombia | 86 | 131 | 121 | 5.9 |
| Bangladesh | 43 | 45 | 47 | 1.5 |
| Iran | 52 | 38 | 41 | -3.9 |
| Republic of Korea | 13 | 12 | 10 | -4.3 |
| Venezuela | 19 | 18 | 18 | -0.9 |
| Morocco | 7 | 17 | 7 | - |
| Iraq | 5 | 2 | 2 | -14.2 |
| Cuba | 2 | 2 | 2 | - |
| Total (13 countries) | 4,177 | 4,096 | 4,782 | 2.3 |

a/ Oil equivalent.

Note: Imports of these countries account for more than 70 per cent of total oil imports of all developing countries.

Source: FAO; UNIDO secretariat calculations.

with very low or negative rates of growth. The main factors responsible for the unsatisfactory performance of a large number of developing countries have been identified by UNIDO[30/] and R. Hancock[31/] as the following:

- Oilseeds and oils have a much lower priority in agricultural planning than grains; price supports given to oilseeds are not sufficiently attractive to promote cultivation of oilseeds under conditions more profitable than grains; investment resources are scarce, infrastructure inadequate and the marketing structures often weak.

- Among the technical constraints to production, the most important one relates to higher yielding and decease resistant varieties suitable to local conditions. Advances made in breeding work in oilseeds and oil-bearing materials and in cultivation practices are not easily transferred to countries where cultivation plots are diseminated, where infrastructure inadequate and where no efforts have been made for integrating production and marketing.

Moreover, often insufficient information is available to these countries, that could aid governments in policy-making in this sector, concerning the applicability of different oil crops, their economic characteristics in a particular ecological environment and their responsiveness to unstable international prices.

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30/ Draft world-wide study on the vegetable oils and fats industry, 1975-2000, UNIDO/ICIS.46, 1977.

31/ Hancock, F. Richard, "The changing role of developing countries in the world economy of fats and oils; effects on the EEC", in: Chemistry Industry, 3 July 1982, pp. 439-442.

## 3. INTERNATIONAL TRADE IN VEGETABLE OILSEEDS, OILS AND MEALS[32/]

### 3.1 General overview

Vegetable oils, fats and meals enter the international market in several forms: unprocessed as oilseeds or processed in the form of oil, meal or as derivatives of industries based on vegetable oils which include a wide range of products, from margarine to toiletries. The bulk of the trade still lies in seeds, oils and meals, but it is the industrially processed products, namely the vegetable oils and fats that are increasing their share at the expense of the unprocessed seeds (see table 3.1 and figure 3.1).

Table 3.1. Vegetable oilseeds and products: total world trade, 1976 and 1982 (thousand metric tons)

| | 1976 | Percentage of total trade[a/] | 1982 | Percentage of total trade[a/] | Annual growth rate (%) Imports | Exports |
|---|---|---|---|---|---|---|
| Seeds | 24,998 | 49.2 | 34,473 | 46.6 | 5.5 | 5.9 |
| Oils | 7,013 | 15.0 | 11,570 | 15.7 | 8.7 | 8.0 |
| Meals | 17,892 | 35.8 | 28,004 | 37.7 | 7.8 | 7.3 |
| Total | 49,903 | 100.0 | 74,047 | 100.0 | 6.8 | 6.7 |

a/ Figures calculated on world imports.

Seeds included: copra, cottonseed, groundnuts, palm kernels, rapeseed, sesame seed, soya beans and sunflower seed.

Source: FAO Trade Yearbooks 1982, 1980 and 1978, Rome 1983, 1981 and 1979.

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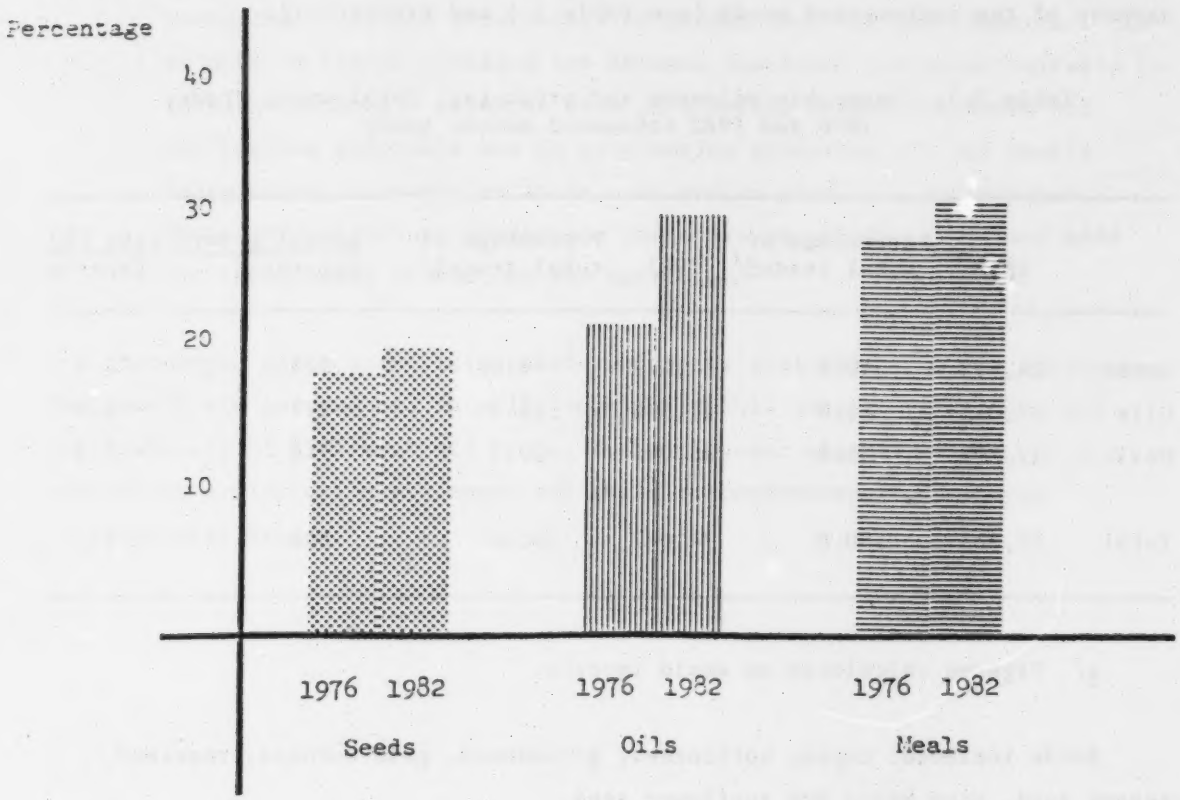
32/ In the Standard International Trade Classification (SITC), the following codes were considered. SITC 221: Oilseeds, oil nuts and oil kernels; SITC 42: Fixed vegetable oils and fats; SITC 55: Essential oils and perfume materials; toilet, polishing and cleaning preparations; SITC 081.3: Oilseed cake and meal and other vegetable oil residues, Standard International Trade Classification, Rev., United Nations, New York, 1961.

**Figure 3.1.**
**Vegetable oils and fats products**
**Proportion of total production traded 1976-1982**



In constant values,[33/] the world export in vegetable oils and fats remained fairly constant until 1970. Thereafter these exports started growing rapidly. Notably, however, it is mainly the developing countries that have contributed to the growth although the developed countries experienced a brief period of higher growth in the early seventies (see figure 3.2).

Table 3.2 presents estimates of the real annual growth rates for exports, (growth rates in values in constant 1975 prices). An increased demand for oilseed for local processing is evident from the very high developing country growth rate in oilseed imports from developed market economies and negative growth rate in oilseed exports to developed market countries. On the other hand, the increasing consumption of oils (and in particular that which could not be covered by domestic production) is demonstrated by the very high growth rates of vegetable oil imports from both developing and developed market economy countries. Developed country imports of vegetable oils from developing countries grew only very slowly, since per capita consumption of oils in the former has grown little and the home processing of oils is encouraged under protection.

When disaggregated by level of processing, the overall growth shows important shifts in product composition. By 1965 oilseeds and oils exports to the developed countries were equally important (figure 3.3), by 1977 oils had become far more important and constituted a preponderant share of product exports, a trend accelerated in all markets after 1976 (figure 3.4).

The reduction in oil seed exports from the developing world in all markets can be partially interpreted as the result of specific policies implemented by governments in the main oilseed producing countries and of technological improvements achieved in the processing and transportation of some vegetable oils[34/] as it is discussed in chapter 7 (figure 3.3 and 3.4).

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33/ Derived from an analysis made by UNIDO of trade flows using chain-linked unit value indices computed from UNSO trade data from 1965 to 1981 with 1975 as base year.

34/ Palm oil from Malaysia, soya bean from Brazil and coconut oil from the Philippines.

Table 3.2. Developing and developed market economy country exports of oilseeds, vegetable oils and toiletries; estimates of the real annual growth rates, 1975-1981 (Percentage)

| Exporters \ Importers | World | Developed market economy countries | Developing countries |
|---|---|---|---|
| Oilseeds | | | |
| Developed market economy countries | 9.5 | 8.5 | 17.1 |
| Developing countries | -2.2 | -6.7 | +9.9 |
| Vegetable oils*/ | | | |
| Developed market economy countries | 11.5 | 7.2 | 15.5 |
| Developing countries | 11.6 | 2.1 | 23.4 |

*/ Toiletries are also included.

Note: Three export flows from the developing countries were considered, namely total exports to the world, exports to developed countries, and their difference, was assumed to be mostly South-South trade since trade flows to the CPE are only 5-10 per cent of total trade. The countries considered for the analysis were all reporters and all partners.

Source: UNIDO estimates of chain-linked unit value indices computed from UNSO trade data and United Nations Yearbook of International Trade Statistics data on current values.

In general, the analysis of trade flows from the developing countries to the world conform two interesting findings: increasing trade among developing countries and increasing exports of industrialized products (oils versus seeds) particularly to the developing world.

Figure 3.2. Exports of vegetable fats and oils products (SITC Rev. 221, 42 and 55) from developing countries to world by regions

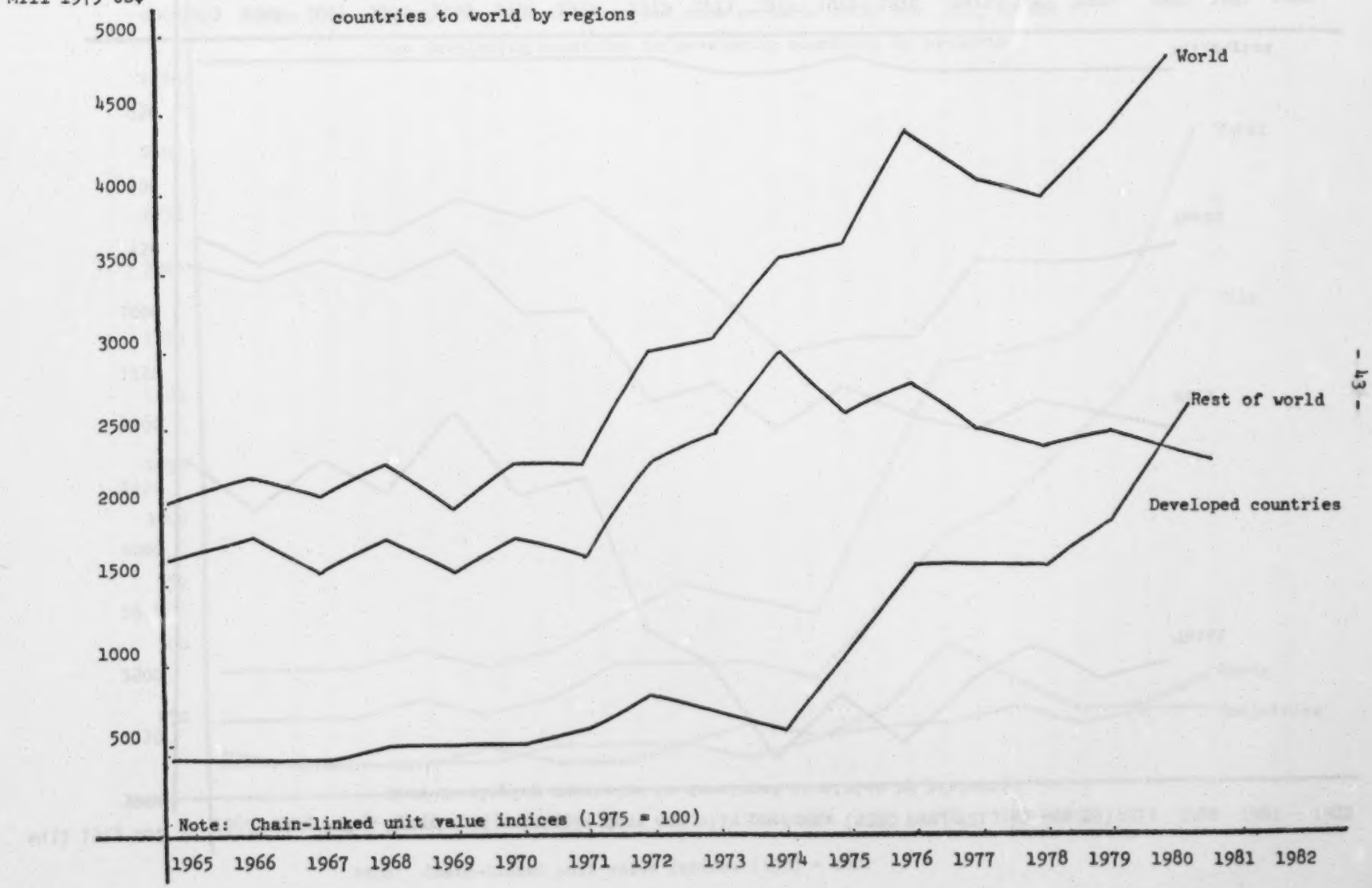
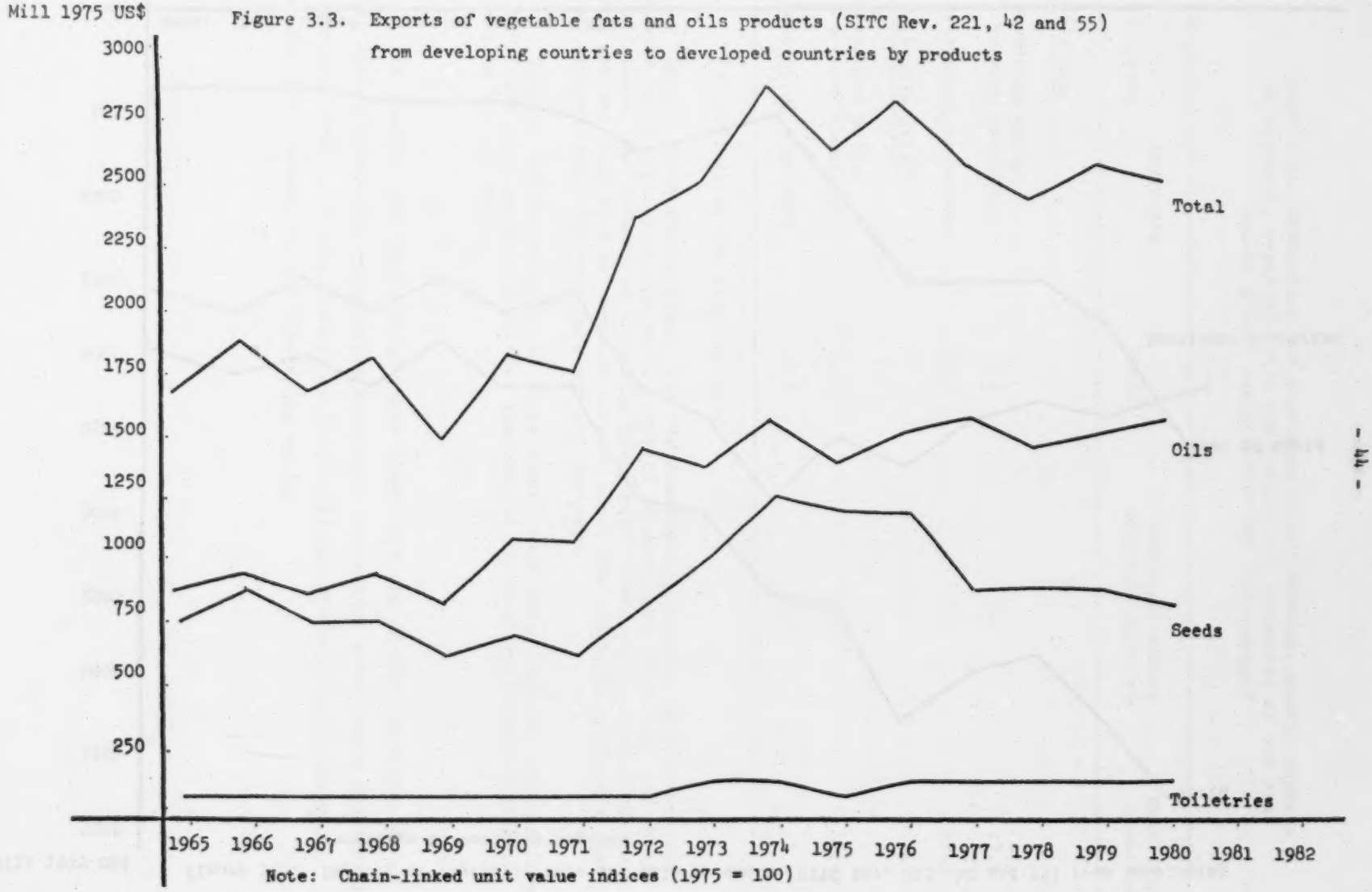
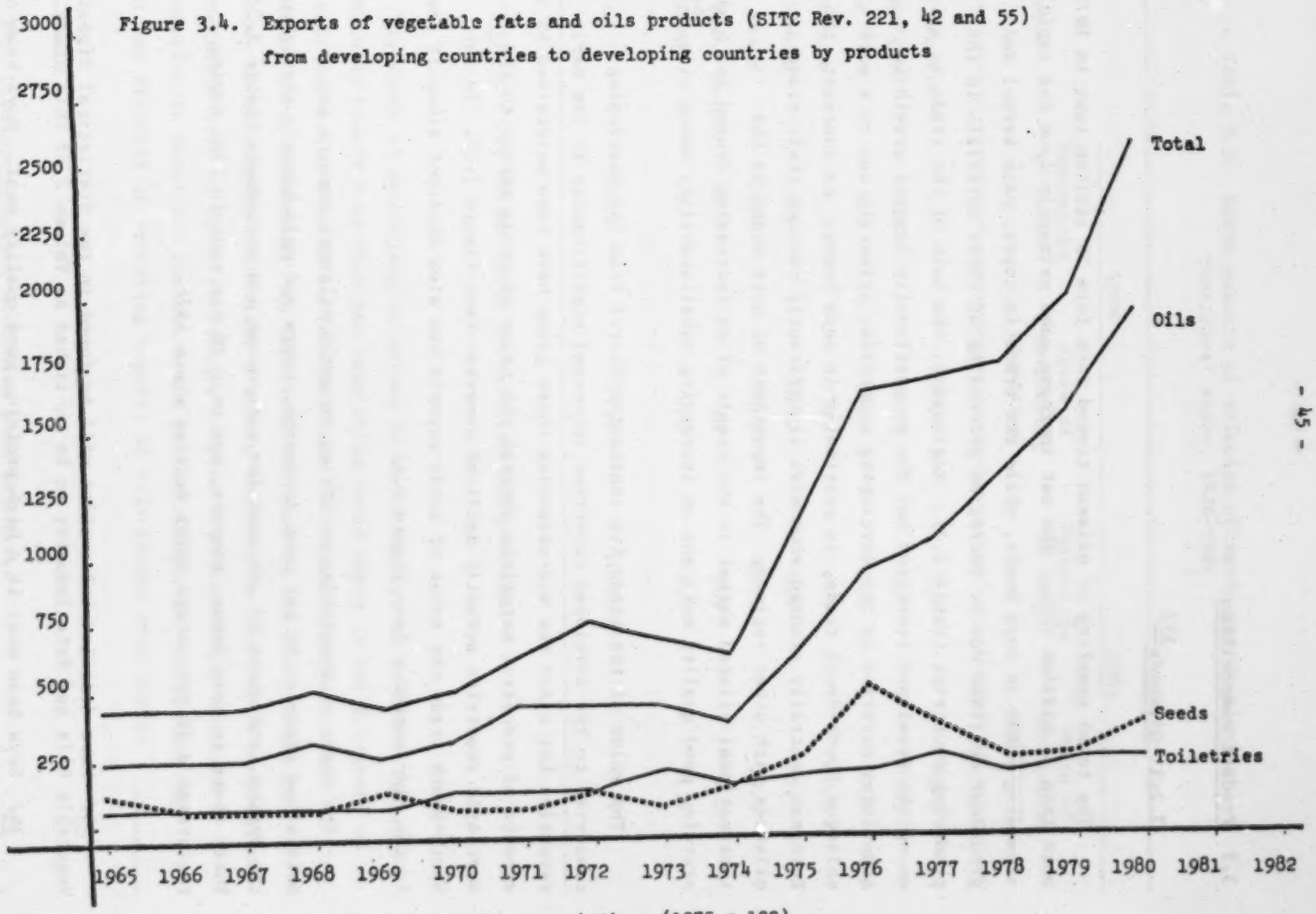


Figure 3.3. Exports of vegetable fats and oils products (SITC Rev. 221, 42 and 55) from developing countries to developed countries by products




Note: Chain-linked unit value indices (1975 = 100)

Figure 3.4. Exports of vegetable fats and oils products (SITC Rev. 221, 42 and 55) from developing countries to developing countries by products




Note: Chain-linked unit value indices (1975 = 100)

## 3.2 Product composition

### 3.2.1 Oilseeds[35/]

The total quantity of oilseed traded rose form 25 million tons in 1976 to more than 34 million tons. The net increase came primarily from the rapidly expanding trade in soya beans, while the trade in copra, palm kernel and groundnut declined due to increased processing of these materials in the producing countries (table 3.3). Regionwise, the bulk of the trade is still among the developed countries but the proportionally largest growth in quantities occurred in the developing countries, primarily due to a much enlarged South-South trade, in particular in soya beans. In contrast, the European centrally planned economies significantly reduced their trade in oilseeds with other regions. The importance of soya beans in the international oilseed market is the result of an increasing demand for high protein, good quality meal and an increasing subsitutability among oils.[36/]

The value of the trade (in constant dollars) from the developing countries to the developed countries increased significantly in the early seventies but since the mid-seventies these gains have been maintained by the exports of processed materials whereas the value of seeds export to the developed countries actually declined somewhat (see figure 3.3). In the South-South trade the value of seeds exports has also declined since it peaked in the mid-seventies (see figure 3.4).

The share of developing countries in world oilseeds exports was maintained close to 90 per cent in sesame, copra and palm kernels throughout the period, and above 40 per cent for cottonseed and groundnuts (table 3.3). Their share in soya beans, however, was only 10 per cent in 1982 having registered a 10 percentage point decline since 1976.

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35/ More detailed information will be found in the Statistical Digest on Vegetable Oils and Fats Industry to be published as Volume 2 of this study.

36/ Soya bean meal is a high protein, good quality meal. Soya bean oil is substituting more expensive oils in conventional applications.

Table 3.3. World exports of selected oilseeds and developing countries' share, 1976-1982

| Oilseeds | 1976 | | 1982 | |
|---|---|---|---|---|
| | Percentage of total | Share of developing countries | Percentage of total | Share of developing countries |
| Palm kernels | 1.6 | 99.8 | 0.6 | 98.3 |
| Sesame seed | 0.9 | 99.6 | 0.7 | 83.5 |
| Copra | 4.8 | 98.6 | 1.3 | 99.8 |
| Groundnuts | 4.1 | 77.9 | 2.3 | 48.8 |
| Cottonseed | 1.2 | 42.1 | 0.4 | 73.7 |
| Soya beans | 79.2 | 20.2 | 82.5 | 10.4 |
| Sunflower seed | 2.1 | 4.0 | 5.9 | 2.2 |
| Rapeseed | 5.7 | 0.6 | 6.3 | 1.1 |
| Total | 100.0 | 27.2 | 100.0 | 12.7 |

Source: Oil World, Unido secretariat calculations.

The share of developing countries in world imports of oilseeds increased drastically from 9.5 to 16.8 per cent while their share in world exports of oilseeds decreased from 28 to 14.4 per cent.[37/] These changes are the result of three phenomena: an important increase in the oil-processing capacity in developing countries; a steady increase in per capita consumption of vegetable oils in these countries, coupled with relatively constant consumption in developed countries and policy changes in the developing countries directed at promoting exports of oils rather than seeds.

37/ Developing market economies plus CPE Asia.

3.2.2 Oils[38/]

Since 1976, the quantity of vegetable oils traded has expanded steadily, with only minor interruptions, at an average annual rate of about 8 per cent. This implies a doubling of supplies in approximately twelve years.

These increases have been accompanied by a market concentration in the trade in vegetable oils. By 1982 soya beans and palm oil, the two leading products, had increased their combined share of the market to 62 per cent. Consequently, producers of other vegetable oils have experienced reduced market shares although quite often their own supplies in absolute terms have increased. For example, the amount of cotton oil traded has increased but not enough to prevent a decrease in its market share. However, the worst performance has been that of groundnut oil: less groundnut oil is traded now than in 1976, which means a quite significant loss of market.

The share of developing countries in world oil imports increased from 34.6 per cent in 1976 to 52.4 per cent in 1982.[39/] In contrast, the share of the developed market economy countries declined from 61 per cent in 1976 to 37.7 per cent in 1982. These developments reflect the increased of consumption of oils in the developing countries. The imports of the European CPE countries are growing rapidly; the reason for this are not apparent.

World exports amounted to 7.4 million tons in 1976 and rose to 11.8 million tons in 1982. While the developing countries' exports in this period almost doubled, practically all of this originated in five major exporting developing countries: Argentina, Brazil, Indonesia, Malaysia and the Philippines. Moreover, these countries actually increased their share in developing countries' oils exports from 80.3 per cent in 1976 to 86.5 per cent

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38/ More detailed information will be found in the Statistical Digest on Vegetable Oils and Fats Industry to be published as Volume 2 of this study.

39/ Developing market economies plus CPE Asia.

in 1982. Thus, oils exports of other developing countries generally rose slower than those of the above five countries, and in many cases stagnated or sometimes even declined. Similarly, the European CPE's share in world exports, already modest, declined further.

The increase in developing countries' exports to other developing countries in particular has been large and rapid since 1974, and is showing no signs of slowing down (see figures 3.3 and 3.4). The developing countries' share in world oils imports grew relatively faster than their share in world exports. This can be explained by the increasing demand for oils in these countries. Since it is only a few developing countries that account for the bulk of the increase in their oils exports, it implies that the increase in developing countries' demand for oils is very impressive.

Out of the nine exporting types of oils considered, the developing countries dominate the international supply of palm oil, palm kernel oil, groundnut oil and coconut oil (see table 3.4). Moreover, in the period 1976-1982, they increased their dominance in all instances, except groundnut oil. Regarding the other oils, the level of developing countries' exports was relatively minor. However, their share in world oils exports of soya bean oil increased mainly due to a growing crush in Brazil and in Argentina. Similarly, their shares in cottonseed oil and in sunflower seed oil increased again due to an extended supply from South America. The share of developing countries in rape remained practically unchanged on a very low level, owing to non-suitable climatic conditions and relatively weak demand.

Among the different types of oils, palm oil dominates the trade, followed by soya bean oil and coconut and sunflower oils (table 3.4). The important position of developing countries in palm oil and palm kernel oil exports is the result of a particularly significant supply of these types of oils by Malaysia, which accounted for 71.9 per cent of all developing countries oils exports in 1981. Important declines in the share of coconut and groundnut oil have occurred although absolute export volumes have been maintained.

Table 3.4. World trade in vegetable oils by type of oils, 1976-1982

| Oils | 1976 | | 1982 | |
|---|---|---|---|---|
| | Percentage of total | Share of developing countries | Percentage of total | Share of developing countries |
| Palm oil | 29.2 | 94.7 | 33.1 | 97.6 |
| Palm kernel oil | 3.8 | 84.9 | 3.7 | 93.8 |
| Groundnut oil | 7.1 | 78.9 | 3.7 | 70.9 |
| Coconut oil | 17.7 | 78.2 | 10.4 | 92.4 |
| Sesame oil | 0.1 | 55.8 | 0.1 | 60.0 |
| Soya bean oil | 24.9 | 29.6 | 28.5 | 31.3 |
| Cotton oil | 3.7 | 11.8 | 4.1 | 21.1 |
| Sunflower oil | 8.0 | 7.5 | 10.0 | 32.5 |
| Rapeseed oil | 5.5 | 0.5 | 6.4 | 1.6 |
| Total | 100.0 | 58.8 | 100.0 | 61.2 |

Source: Oil World, UNIDO secretariat calculations.

3.2.3 Oilmeals and cakes

In 1976, world exports of the major vegetable oilmeals amounted to 17 million tons, of which soya bean, groundnut and cotton seed cakes and meals accounted for 86 per cent. By 1982, exports of oilcakes and meals had grown to 28 million tons. The developing countries account for approximately half of world exports but their share in imports is still small (12 per cent in 1982) albeit growing rapidly during the 1976-1982 period an annual growth rate of 20.1 per cent was realized.

In the world trade, soya bean meal has increased its market share dramatically over the period and now accounts for 81 per cent of traded supplies. But trade in groundnut and cottonseed meals underwent an absolute decline and consequently their combined share has declined (see table 3.5).

The increasing importance of soya bean meal in the world market results from the large demand for high-protein meals for livestock production in the developed countries and from a growing demand for these products in the European CPE and in the developing countries[40/] (see table 3.6).

Compared to other vegetable oils and fats products, the value of oilcakes and meals exports from the developing countries to other regions has not risen quite as fast possible because oil palm, which is a big oil crop in the developing countries, does not have an associated meal. However, as with the other products, the value of exports began to rise in real terms around the mid-seventies (see figure 3.5).

Table 3.5. Vegetable meals: exports and share of developing countries by type of meal, 1976-1982 (Percentage)

| Meals | 1976 | | 1982 | |
|---|---|---|---|---|
| | Percentage of total | Share of developing countries | Percentage of total | Share of developing countries |
| Soya bean meal | 69.2 | 40.1 | 80.8 | 44.9 |
| Cotton meal | 5.4 | 81.1 | 3.2 | 86.5 |
| Groundnut meal | 11.7 | 97.4 | 2.8 | 94.7 |
| Sunflower meal | 2.5 | 81.6 | 3.7 | 69.5 |
| Rapeseed meal | 2.4 | 42.3 | 2.7 | 25.2 |
| Sesame meal | 0.3 | 98.5 | 0.1 | 96.7 |
| Copra meal | 6.2 | 93.9 | 4.2 | 97.0 |
| Palm kernel meal | 2.3 | 78.3 | 2.5 | 98.8 |
| Total | 100.0 | 54.5 | 100.0 | 51.5 |

Source: Oil World, UNIDO secretariat calculations.

40/ As illustrated by very high growth rates in the compound feed industry, registered in the period 1974-1981.

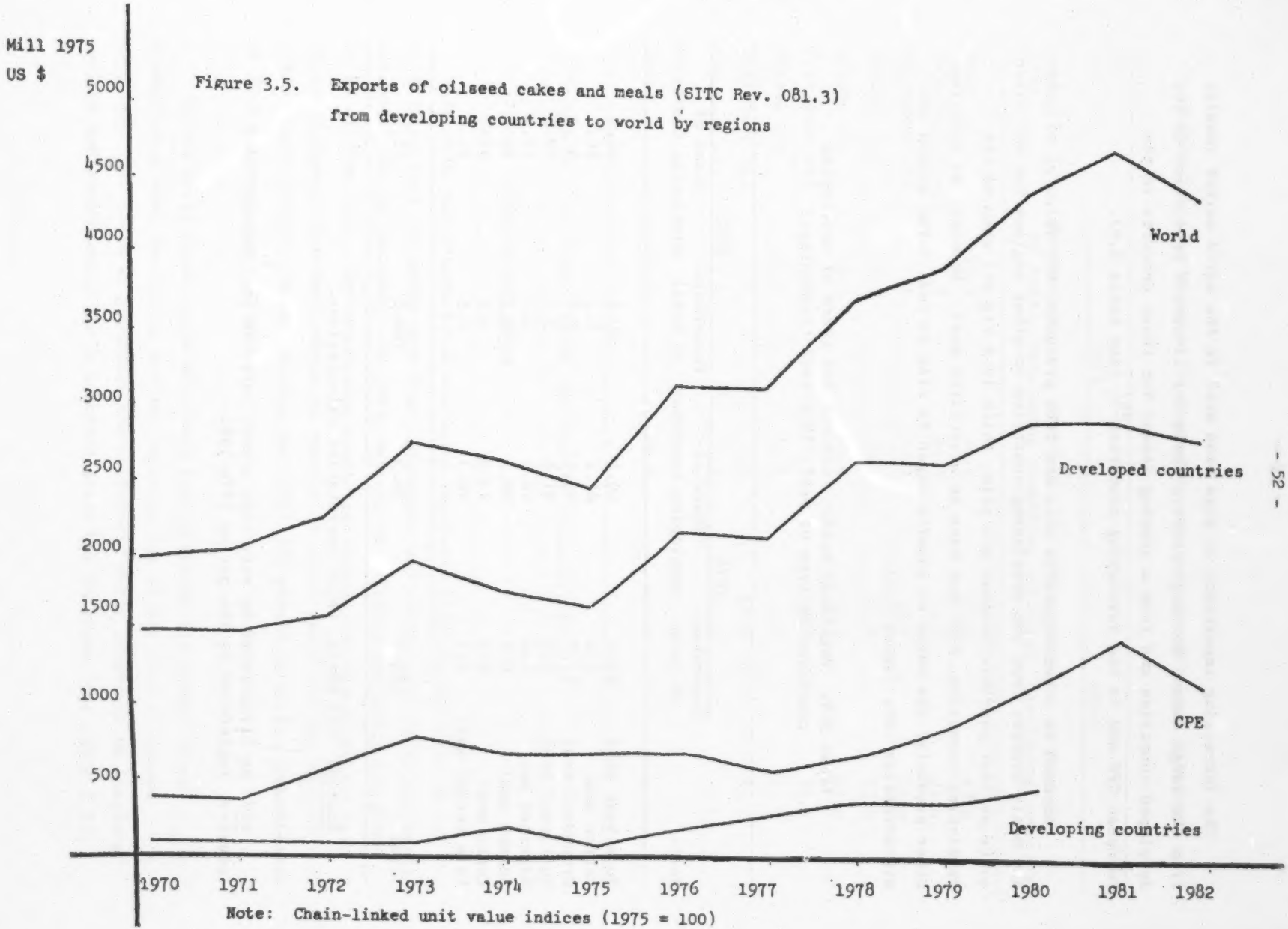


Figure 3.5. Exports of oilseed cakes and meals (SITC Rev. 081.3) from developing countries to world by regions

Note: Chain-linked unit value indices (1975 = 100)

Table 3.6. Production of the compound feed industry - world and selected countries, selected years and annual growth rate

(Thousand metric tons)

| | 1974-76 Average | 1977 | 1978 | 1979 | 1980 | 1981 | Growth rates 1974-76 to 1981 |
|---|---|---|---|---|---|---|---|
| World | 289,855 | 316,871 | 342,003 | 360,495 | 371,442 | 376,913 | 4.5 |
| Developing | 20,385 | 27,772 | 32,867 | 37,011 | 40,683 | 43,236 | 13.4 |
| Argentina | 1,100 | 1,300 | 1,500 | 1,800 | 1,850 | 1,900 | 9.5 |
| Brazil | 6,900 | 8,600 | 10,300 | 11,100 | 11,400 | 11,700 | 9.2 |
| Colombia | 290 | 450 | 600 | 700 | 1,100 | 1,200 | 26.7 |
| Egypt | 150 | 490 | 800 | 1,100 | 1,640 | 1,700 | 49.9 |
| India | 700 | 900 | 1,000 | 1,100 | 1,150 | 1,150 | 8.6 |
| Iran | 100 | 160 | 190 | 200 | 200 | 220 | 14.1 |
| Republic of Korea | 1,070 | 1,890 | 2,700 | 3,300 | 3,500 | 3,600 | 22.5 |
| Malaysia | 319 | 386 | 444 | 465 | 475 | 490 | 7.4 |
| Mexico | 3,167 | 3,780 | 3,930 | 4,400 | 4,600 | 5,000 | 7.9 |
| Morocco | 80 | 84 | 137 | 165 | 210 | 274 | 22.8 |
| Nigeria | 135 | 210 | 260 | 300 | 400 | 460 | 22.7 |
| Saudi Arabia | 15 | 90 | 180 | 250 | 300 | 400 | 72.8 |
| Tunisia | 130 | 200 | 250 | 350 | 450 | 600 | 29.0 |
| Turkey | 484 | 712 | 937 | 1,271 | 1,449 | 1,500 | 20.7 |
| Venezuela | 1,233 | 1,500 | 1,700 | 1,700 | 1,700 | 1,800 | 6.5 |

Source: FAO and ITC, 1983.

### 3.2.4 Toiletries[41/]

In relative terms, toiletry exports have grown in parallel to oils exports. In 1965 their exports were almost equally divided between the developed and the developing countries but most of the growth since then has been to the developing countries[42/] which are now their main export market (figure 3.6).

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41/ SITC 55, essential oils and perfume materials, toilet, polishing and cleaning preparations.

42/ Rest of world in figure 3.5 since trade with CPE countries is very low.

## 3.3 Obstacles to trade in oilseeds, vegetable oils and related products[43/]

This section examines the level and structure of nominal (ad valorem) tariff rates facing developing country exports of oilseeds, oils and related products in selected markets. Tariff structure refers to the relative size of tariffs at different stages in the processing chain. Ordinarily, industrial nations escalate their tariff structure according to the fabrication stage of a competitive import. Raw materials enter virtually duty free. Thus, tariff escalation inhibits the development of final processing activities in developing countries by encouraging the export of products in less processed form.

An important point which needs to be mentioned in the context of tariff escalation is that in order to assess its influence on developing country exports, consideration must be given to underlying demand conditions. Casual observations as to whether tariffs rise or fall (or even remain constant) in the movement from primary to processed products is not sufficient. Specifically, in evaluating the impact of tariff escalation, account has to be made of import demand elasticities. If import demand elasticities tend to move inversely with the stage of processing, then the escalating tariff (or non-tariff) structures do not necessarily indicate a bias against processed goods. But the overwhelming evidence from numerous studies that have estimated developed countries' import demand elasticities show, however, that these in fact increase with the degree of fabrication. For example, in the case of vegetable oils, estimates of the import price elasticities increase from about 0.4 for oilseeds to about 1.14 for processed oils.[44/] Consequently, a significant de-escalation of tariffs (or other forms of trade barriers) is required in order not to be a bias there against trade in processed goods.

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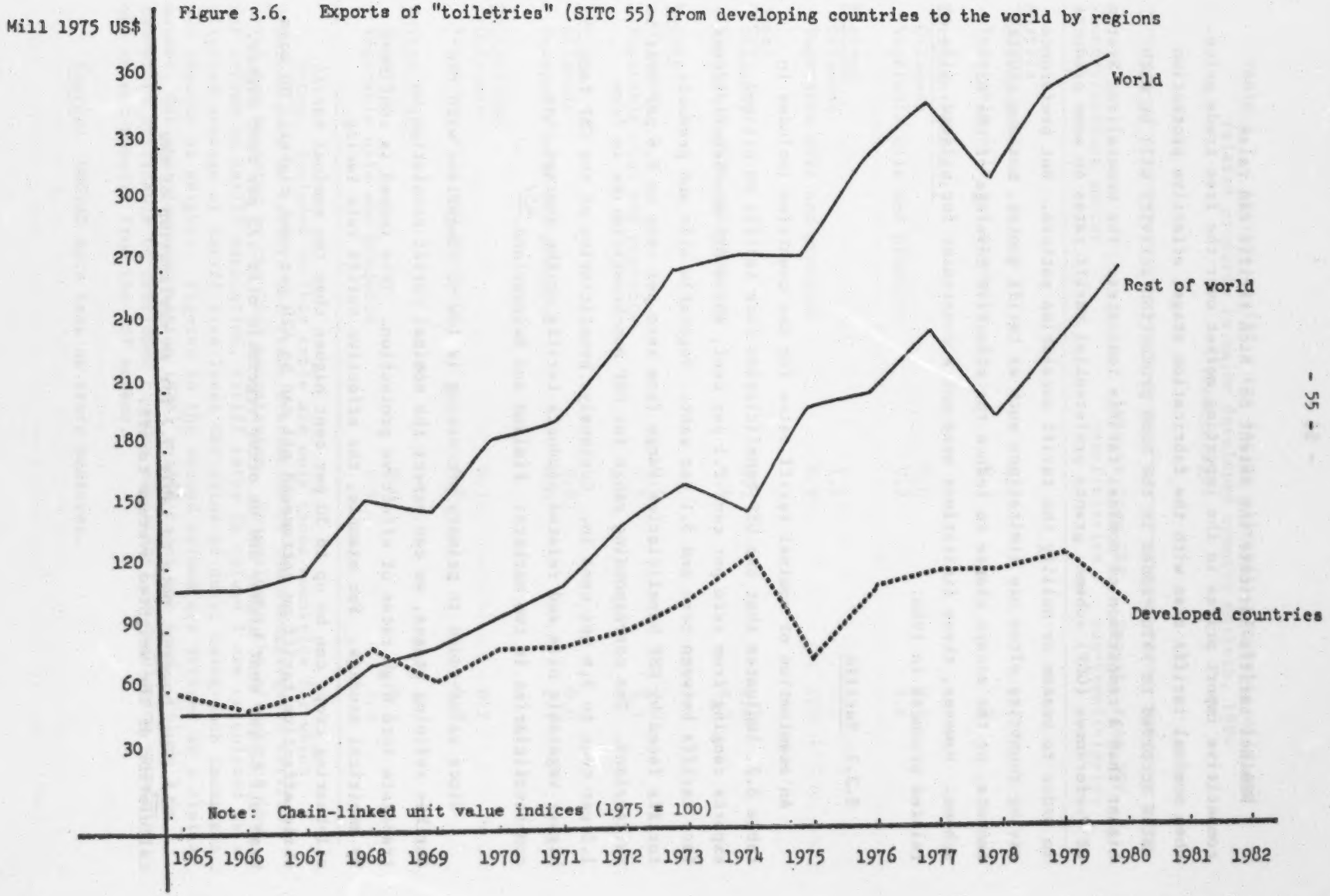
43/ This section is based on a study "Tariff and Non-tariff Measures in the World Trade of Oilseeds, Vegetable Oils and Related Products", prepared for UNIDO by the UNCTAD secretariat, Geneva, March 1984, to be published as a separate document.

44/ R. Stern, J. Francis and B. Schumacher, Price Elasticity in International Trade, London, 1976.

Figure 3.6. Exports of "toiletries" (SITC 55) from developing countries to the world by regions



Nominal tariffs indicate the extent to which tariffs can raise competitive import prices in the importing market over the free trade price. When nominal tariffs rise with the fabrication stage, effective protection rates accorded to value-added in the home production activity will be much higher than a comparison of nominal tariffs indicates. The Generalized System of Preferences (GSP) scheme, grants preferential tariff rates on some products in order to weaken or nullify the tariff escalation pattern. But preference-giving countries often use limitations such as tariff quotas, maximum country amounts, or the escape clause to reduce the effective coverage of the GSP scheme. However, these limitations were not a constraint for oilseed, oils or related products in 1980.

### 3.3.1 Tariffs

An examination of nominal tariff rates for the countries included in table 3.7, indicates that the GSP beneficiaries face tariffs on oilseed exports ranging from zero per cent 2.1 per cent, while GSP non-beneficiaries face tariffs between zero and 5.1 per cent. Vegetable oils and products tariffs faced by GSP beneficiaries range from zero per cent to 8.6 per cent in Switzerland. The corresponding range for GSP non-beneficiaries is from 1.2 per cent to 9.6 per cent in. Curiously, beneficiaries of the GSP face higher vegetable oils and related products tariffs on the average than non-beneficiaries in two markets: Finland and Switzerland.[45/]

Since value-added in primary processing is low in comparison with the further refining stages, we can expect the nominal tariff escalation to translate into high rates of effective protection. This indeed is confirmed by empirical studies. For example, the effective tariff rate facing oil-bearing crops can be up to 30 per cent higher than the nominal tariff, while effective tariff on cottonseed oil can be 420 per cent higher; on soya bean oil 62 per cent higher and on other vegetable oils 175 per cent higher.

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45/ See, however, note to table 3.7 for an explanation of the calculation of the weighted average tariff.

Table 3.7. Average tariff rates facing oilseeds, vegetable oils and related products in major developed country markets, 1980
(Percentage)

| Country/product sector | Imports from GSP beneficiaries | Imports from GSP non-beneficiaries |
|---|---|---|
| Austria | | |
| Oilseeds | 0.1 | 1.1 |
| Vegetable oils and products | 0.3 | 3.0 |
| European community | | |
| Oilseeds | 0.0 | 0.0 |
| Vegetable oils and products | 7.2 | 9.6 |
| Finland | | |
| Oilseeds | 1.1 | 1.1 |
| Vegetable oils and products | 4.9 | 1.2 |
| Japan | | |
| Oilseeds | 2.1 | 4.8 |
| Vegetable oils and products | 4.4 | 8.3 |
| Norway | | |
| Oilseeds | 0.0 | 0.0 |
| Vegetable oils and products | 1.5 | 3.1 |
| Sweden | | |
| Oilseeds | 0.0 | 0.0 |
| Vegetable oils and products | 0.0 | 2.7 |
| Switzerland | | |
| Oilseeds | 0.1 | 0.2 |
| Vegetable oils and products | 8.6 | 4.9 |
| United States | | |
| Oilseeds | 0.0 | 5.1 |
| Vegetable oils and products | 1.1 | 3.5 |

Notes: Included in this table are only those countries for which detailed data on tariffs and trade statistics at the disaggregated tariff level are reported by the GATT secretariat. To evaluate the effects of the GSP scheme on tariff escalation, tariff rates in column 1 are calculated as a weighted average of tariff line level GSP rates of duty, using each country's own imports as weights. Figures in the second column are derived in a similar manner, but most-favoured-nation (MFN) tariff rates are used. Column 2 is therefore applicable to developed country exporters, or developing countries who do not benefit from the GSP scheme.

Source: UNCTAD data base on trade measures.

Given the levels of tariff aggregation used in the national tariff schedules of developing countries, a detailed analysis of tariff escalation is not possible. However, unweighted tariff averages can be constructed for oilseeds, oils, fats and animal feed imports for a number of developing countries. Such tariff rates are presented in table 3.8. The rates shown here are generally much higher than the corresponding nominal tariff rates in the developed market economy countries. Even higher rates are encountered in some countries for certain products. Worse yet, these rates tend to be very high for the products originating from the developing countries, for example up to 250 per cent for palm oil and coconut oil, whereas for soya bean which comes primarily from developed countries the rates are significantly lower.[46/] However, lately Malaysia has conducted successful discussions with its trading partners to have their tariff rates reduced. Also, when, the state or its agent acts as the importer, the tariffs are often waived.

### 3.3.2 Non-tariff measures

A large number of non-tariff measures are applied to imports of oilseeds, vegetable oils and products in the markets of both developed and developing market economy countries. A few countries appear not to use non-tariff measures in respect of vegetable oil imports, but most apply a large variety of controls. Although the effects of non-tariff measures on import volumes and price levels are extremely difficult to quantify, an indication of their incidence pattern can be determined by comparing a frequency distribution of their applications on product groups by developed and developing countries (see table 3.9).

Some important differences in the application pattern of non-tariff measures emerge. Firstly, developed countries rely on a wider variety of non-tariff measures. The ones used most frequently are licensing and quotas, followed by variable levies. Secondly, developing countries also place heavy reliance on volume controls (including prohibition), but do not rely on price-controlling measures, since they have a greater interest in importing products at the lowest possible cost.

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46/ FAO CCP: OF 80/4, "Expanding Trade in Fats and Oils Among Developing Countries - Opportunities, Constraints and Policy Needs", Rome, February 1980.

Table 3.8. Average ad valorem tariff rates on oilseeds and oils[a/] in selected developing countries

| Region/country | Year | Tariff (Percentage) |
|---|---|---|
| Africa | | |
| Egypt | 1977 | 10.8 |
| Ghana | 1977 | 26.8 |
| Ivory Coast | 1977 | 8.7 |
| Malawi | 1977 | 3.1 |
| Mauritius | 1979 | 5.3 |
| Morocco | 1978 | 17.9 |
| Tunisia | 1977 | 24.0 |
| Zaire | 1978 | 7.5 |
| Asia | | |
| Cyprus | 1978 | 5.2 |
| India | 1976 | 61.9 |
| Republic of Korea | 1976 | 32.9 |
| Pakistan | 1977 | 55.5 |
| Philippines | 1977 | 46.4 |
| Americas | | |
| Argentina | 1979 | 10.8 |
| Bahamas | 1977 | 20.9 |
| Bolivia | 1977 | 10.6 |
| Brazil | 1977 | 35.1 |
| Colombia | 1977 | 16.7 |
| Jamaica | 1976 | 9.2 |
| Paraguay | 1978 | 17.0 |

a/ Including animal fats.

Source: National tariff schedules.

Table 3.9. Selected direct import control measures applied in 23 developed market economy countries and 22 developing countries, on oilseeds and their products (percentages)

| Importing markets | Measure | Frequency of application | | |
|---|---|---|---|---|
| | | All products | Oilseeds | Oils and products |
| Developed countries | Prohibition | 1.9 | 2.2 | 1.9 |
| | Quota and licensing | 22.2 | 21.7 | 22.4 |
| | Automatic authorization | 4.8 | 6.5 | 4.3 |
| | Variable levy | 9.7 | | 12.4 |
| Developing countries | Prohibition | 11.1 | 9.1 | 11.7 |
| | Quota and licensing | 22.7 | 34.1 | 19.5 |
| | Automatic authorization | | | |
| | Variable levy | | | |

Source: UNCTAD.

The figures in table 3.9 are high in comparison to frequency indices for volume-restraining measures on agricultural products in general and on all products.[47/] Interestingly, the frequency indices do not display a marked tendency for non-tariff measures escalation by fabrication stage; in fact, quotas and licensing are almost twice more frequent in developing countries in the case of oilseeds than in the case of their products.

47/ See UNCTAD, TD/B/940, op.cit.

In addition to the above various fiscal measures are used by many with a frequency in excess of that calculated for quotas and licensing.[48/] Another type of measure to be noted are the health and sanitary requirements applied by almost all countries. The severity of these requirements and the complicated procedures involved can be used to impede or even prevent imports.

An analysis limited to the European Community reveals that about 4.5 per cent of the total European Community imports of oilseeds, vegetable oils and related products are subject to one or more of the measures analyzed. The share, however, is much higher in the case of imports from developing countries (7.5 per cent) than from the developed market-economy countries (2.9 per cent), or the centrally planned countries of Eastern Europe and Asia (less than 0.1 per cent). Individual countries show even greater divergence in their treatment of imports from developing countries compared to imports from the developed market economy countries.

### 3.3.3 Prices in the world markets

Real prices for the major export products (seeds, oil and toiletries) remained relatively stable from 1965 to 1973 when they suddenly shot upwards in response to unusual supply shortages, strong demand as well as unsettled conditions on the commodity markets.[49/] By 1981, the prices were nearly double what they had been in 1965. Since then, however, real prices for seeds and oils have started to come down somewhat in response to very large supplies accompanied by often stagnant or even declining demand due to generally unfavourable economic conditions. The severe balance of payments situation in many countries also aggravated the situation by reducing their import possibilities. The prices for toiletries, being less directly connected to the commodity markets, have continued their steady climb (see figure 3.7).

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48/ The European Economic Community intends to introduce a new tax on fats and oils which - according to the FAO Intergovernmental Group on Oilseeds, Oils and Fats - would be discriminatory and therefore would not be a tax on consumption but a new barrier to trade, CCP: OF 84, Intergovernmental Group on Oilseeds, Oils and Fats, Eighteenth Session, Rome, 20-24 February 1984, paragraph 20.

49/ FAO Commodity Review and Outlook, 1977-1979, chapter III "The World Oilseeds and Oil Economy: Projections and Prospects to 1985".

Around 1977-1978 a certain amount of surplus production of both seeds an oils started to emerge. This has contributed to the increased instability in the real prices for these products or the world markets. Another contributing factor is the improved technology that has increased the possibilities to substitute the relatively cheaper raw materials (oil palm and soya bean) for the more higher priced oil materials (groundnut and partially coconut, appendix 1). This has led the producers of the different materials to jockey for market share by alternating their prices. The net result is price unstability which will continue until the production of the various prices settle to levels that correspond to their relative efficiency prices.

Developed countries often respond to pleas from their producers and consumers who want stable prices by relying less on tariffs and more on non-tariff measures to achieve internal price stability. However, as table 3.10 indicates, non-tariff measures which achieve internal price stability accentuate instability elsewhere. When a domestic market is insulated from the impact of changing conditions in the world market, all the price-adjustment burdens are forced upon the latter. The result is increased price instability in the world market. However, insulation from the world market occurs on a very few cases[50/] in the vegetable oils and fats economy, contrary to what happens in other commodities.

When, for example, a cyclical decrease in world agricultural prices results from an oversupply of the goods in major importer countries, these importers can use various non-tariff measures in order to reduce imports. The resulting decline in world demand for these products would place downward pressure on world prices. When a reduced world supply drives world prices up, importers can relax their import volume controls. The resulting increase in world demand places upward pressure on world prices.

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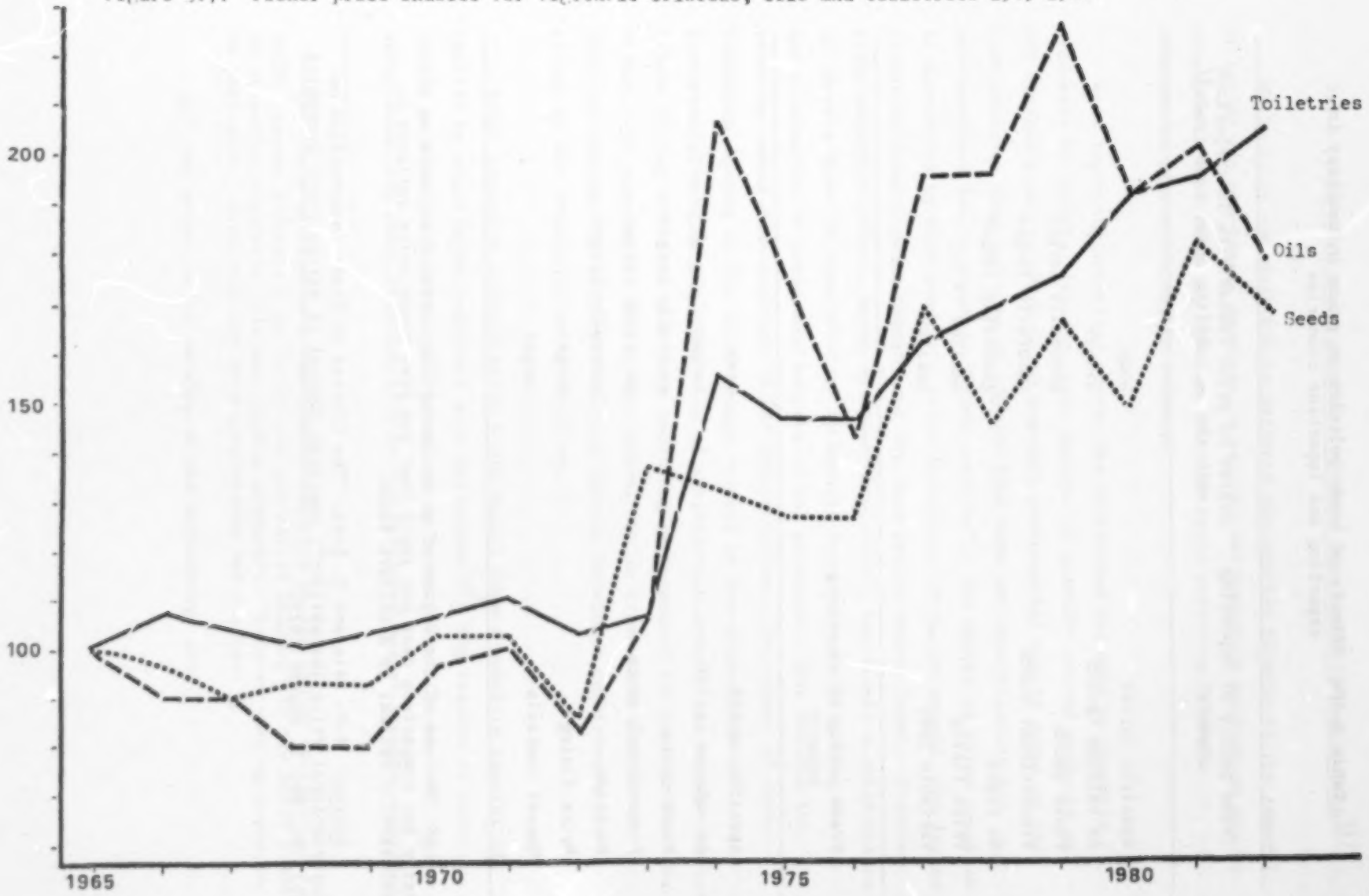
50/ Olive oil in the EEC and groundnut oil in the U.S.A.

Figure 3.7. Fisher price indices for vegetable oilseeds, oils and toiletries 1965-1982




Source: UNIDO Secretariat calculations based upon unit values

Table 3.10. Effects of trade policies on price instability in exporting and importing countries

| Trade policy of importing country | Degree of price instability in comparison with the instability under free trade[a/] |
|---|---|
| Specific tariff | same |
| Ad valorem tariff | larger |
| Fixed quota | generally larger |
| Proportional quota | generally larger |
| No trade | generally larger |
| Price fixing | smaller (≥ 0) |
| Variable levy | smaller |
| **Trade policy of exporting country** | |
| Specific tariff | same |
| Ad valorem tariff | larger |
| Fixed quota | generally larger |
| Proportional quota | generally larger |
| No trade | generally larger |
| Price fixing | larger |
| Export controls | larger |

a/ The use of the degree of price instability under free trade as a basis for comparison does not imply that the free trade price variance is necessarily optimal in a welfare sense.

Source: M.D. Bale and E. Lutz, "The Effects of Trade Intervention on International Price Instability", American Journal of Agricultural Economics, Vol. 61, No. 3, August 1979.

### 3.3.4 Potential trade expansion effects from trade liberalization[51/]

While is is not possible to estimate the precise effects of the removal of tariff and non-tariff measures, a partial and tentative evaluation may be attempted. Specifically, the expansion of trade resulting from the elimination of tariffs may be assessed.

When importing countries remove the protection accorded to domestic producers by tariffs, they increase imports of non-GSP covered products and GSP covered products which faced non-zero preferential tariff rates in the base period. This increase in imports from both GSP beneficiaries and non-beneficiaries is known as "trade creation". The degree of trade creation is determined by each product's price elasticity of import demand, the degree of tariff induced price change, and the base period import level. A second trade expansion effect, known as "trade diversion", represents a substitution of imports from GSP beneficiaries by imports from non-beneficiaries, due to the elimination of preference margins on GSP products. This worsens the relative competitive position of GSP beneficiaries. The extent of trade diversion depends on the price change induced by the elimination of preferential margin, the elasticity of substitution between two supply sources (those facing MFN rates and those receiving preferences) for each product and market, and base-period MFN import levels. While trade diversion is a positive outcome for GSP beneficiaries (mostly developed countries), its effect on GSP beneficiaries is negative.

Trade expansion effects which would result from a complete removal of tariffs by eight major importers were estimated.[52/] The results of this tariff elimination exercise are presented in table 3.11. Column 1 of this table shows the trade creation effects for developed market economy countries.

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51/ This section is based upon an analysis by the UNCTAD secretariat for UNIDO, issued separately as Tariff and non-tariff measures in the world trade of oilseeds, vegetable oils and related products. Sectoral working paper to be published. Here only the main conclusions are recited.

52/ See annex 1a for details of the methodology used.

Trade creation effects for developing country beneficiaries and non-beneficiaries are listed in column 2. A range of trade diversion estimates, corresponding to two different substitution elasticity estimates, is shown in the next two columns. These represent potential gains to GSP non-beneficiaries and potential losses to developing country GSP beneficiaries. The remaining columns summarize net trade expansion effects for each country grouping, followed by a comparison of these effects expressed as a percentage of 1980 base-period imports.

The results indicate that the erosion of GSP preference margins by the removal of the MFN tariffs would bring serious consequences for developing countries in several markets. With only minor exceptions, these countries offer duty-free entry for those products covered by their GSP schemes. This is reflected in the relatively large trade diversion estimates. Furthermore, developing countries would face zero or negative trade expansion (depending on which estimate of the trade diversion - high or low - is considered).

Developing countries would enjoy the highest net trade expansion effects in the EEC and Japanese markets. Over 60 per cent of GSP covered products in the EEC, and nearly half of the GSP covered products in Japan, have non-zero preferential rates which differ by 50 per cent or less from MFN rates. Preference margins are therefore small and trade diversion is small relative to the trade creation effects for developing country exports to these markets.

Overall, when compared to the base period value of trade, the net effects of tariff removal are marginal. The upper limit for developing country trade expansion is less than one and a half per cent of 1980 base period import values. There are a number of reasons for expecting small potential net trade expansion effects for developing countries. First, tariffs on these products are not very high and present stimates include only net gains or losses accruing after the 1980 base period when tariffs were removed. Developing countries have already enjoyed benefits from earlier trade barrier liberalization and from the GSP programme which further tariff removal cannot enhance. Finally, a number of importers have granted zero GSP rates on these products; hence the preference margin loss equals the MFN tariff rate.

Table 3.11. Estimated trade effects from a complete removal of post-Tokyo round tariffs facing oilseeds, vegetable oil product exporter in major developed market economy importers (value in thousands of 1980 US dollars)

| | Trade Creation | | Trade Diversion | | Net Trade Expansion | | | | Net trade expansion as percentage of base-period imports | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DMECs | Developing countries | | | DMECs | | Developing countries | | DMECs | | Developing countries | |
| | | | Low Estimate | High Estimate | Low Estimate | High Estimate | Low Estimate | High Estimate | Low Estimate | High Estimate | Low Estimate | High Estimate |
| AUSTRIA | 1,520.7 | 39.7 | 795.1 | 1,322.1 | 2,315.8 | 2,842.8 | -755.4 | -1,282.4 | 4.0 | 4.9 | -7.3 | -12.3 |
| EEC | 21,001.9 | 52,257.7 | 7,695.8 | 12,826.3 | 28,697.7 | 33,828.2 | 44,561.9 | 39,431.4 | 0.7 | 0.9 | 1.9 | 1.7 |
| FINLAND | 1,145.9 | 238.9 | 11.3 | 18.8 | 1,157.2 | 1,164.7 | 227.6 | 220.1 | 0.7 | 0.7 | 2.1 | 2.1 |
| JAPAN | 49,457.1 | 5,708.4 | 2,700.5 | 4,500.8 | 52,157.6 | 53,957.9 | 3,007.9 | 1,207.6 | 3.0 | 3.1 | 1.1 | 0.4 |
| NORWAY | 299.4 | 58.6 | 59.8 | 99.3 | 359.2 | 398.7 | -1.2 | -40.7 | 0.3 | 0.4 | 0.0 | -0.2 |
| SWEDEN | 1,115.5 | 1.5 | 2,396.9 | 3,994.5 | 3,512.4 | 5,110.0 | -2,395.4 | -3,993.0 | 4.7 | 6.9 | -6.3 | -10.5 |
| SWITZERLAND | 1,097.0 | 1,560.3 | 191.6 | 319.3 | 1,288.6 | 1,416.3 | 1,368.7 | 1,241.0 | 1.7 | 1.9 | 3.5 | 3.2 |
| UNITED STATES | 1,345.1 | 2,181.1 | 2,813.4 | 4,689.0 | 4,158.5 | 6,034.1 | -632.3 | -2,507.9 | 4.6 | 6.7 | -0.1 | -0.5 |
| TOTAL | 58,081.6 | 62,046.2 | 16,664.4 | 27,770.4 | 93,647.0 | 104,752.7 | 45,381.8 | 34,276.1 | 1.5 | 1.7 | 1.4 | 1.0 |

Source : UNCTAD estimates.

Note : "Low estimate" is based on the low elasticity of substitution and "high estimate" is based on the high elasticity of substitution.

However, a finding of small potential net trade expansion effects for developing countries, when tariffs are removed, is not an argument against trade barrier liberalization. The negative impact of tariff escalation by stage of fabrication and its impact on developing country exports and industrialization attempts, remain. Moreover, trade liberalization entails favourable income effects which would create additional trade expansion. Lastly, considerable gains could accrue to the developing countries through the elimination of the many non-tariff distorting measures.

In fact, these gains may indeed be quite considerable. An evaluation of a 50 per cent reduction in all barriers to trade in agricultural commodities[53/] suggest that the increase in total OECD imports would be much more than that indicated by above results. The large difference seems to point to a strong trade restrictive influence of non-tariff measures.

In summary, the above analysis of trade indicates, for the period under consideration, that

(1) trade has grown faster than production and industrially processed products are increasing their share at the expense of unprocessed seeds;

(2) the growing share of developing countries in the world trade can be accounted for by an expansion in South-South trade and an important growth in consumption in these countries;

(3) a continuous concentration in trade is evident, with soya beans, soya bean oil and palm oil playing the main role; and

(4) in future negotiations, more emphasis should be placed on removing existing tariffs in developing countries and non-tariff measures being applied both by developing and developed countries.

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53/ A. Valdes, Trade Liberalization in Agricultural Commodities and the Potential Foreign Exchange Benefits to Developing Countries, International Food Policy Research Institute, Washington D.C., 1979.

## 4. PRESENT AND FUTURE CONSUMPTION OF VEGETABLE OILS AND FATS

There are no generally recognized minimum daily requirements for fat consumption. Moreover, consumption patterns among the developed countries (where levels of 4^ per cent of total calories derived from fat are frequent) should not be taken as a norm, as the consumption of fat is, from a nutrional and health point of view, often too high in these countries. However, FAO considers that in developing countries an increase of energy supplied by fat from the present level near 10 per cent to 15 or 20 per cent (with adequate regard to essential fatty acids) should be desirable[54/]. This suggests that, from the point of view of human needs, per capita consumption of fat in the developing countries should be 50 to 100 per cent higher than current levels. In economic terms, it would mean a very high potential demand for vegetable oils and fats in the domestic market, given the right conditions.

Due to the problems attached to the measurement of human intake of fats and oils at the national level, the concept apparent consumption is used for the following analysis. Apparent consumption is defined as the sum of domestic production and net imports (i.e. imports minus exports). As such, it is a rough measure of availability of a commodity.

### 4.1 World outlook

World total apparent consumption of visible fats and oils of vegetable and animal origin grew at an average rate of 2.3 per cent per year in the period 1976-1982 and reached a level of 62 million tons in 1982. The share of the developing countries rose from 39 per cent in 1976 to 46 per cent in 1982. Still, the annual per capita apparent consumption of total fats was more than three times as large in the developed world as in the developing countries (table 4.1). The growth rates of total fat per capita consumption during the 1976-1982 period were low in the developed countries where

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54/ FAO, Dietary fats and oils in human nutrition, Food and Nutrition Series No. 20, Rome, 1980.

saturation levels are being reached[55] while they were generally high in the developing world, although with great fluctuations from region to region (table 4.2).

Table 4.1. Apparent consumption of total visible fats and oils[a], 1976 and 1982

| | Total fat consumption (thousand metric tons) | | Per capita consumption of total fat kg/cap/year | |
|---|---|---|---|---|
| | 1976 | 1982 | 1976 | 1982 |
| World | 48,705 | 62,101 | 11.8 | 13.5 |
| Developed economies | 29,821 | 33,332 | 26.3 | 28.1 |
| Market economies | 22,207 | 24,936 | 29.0 | 31.1 |
| CPE | 7,614 | 8,396 | 20.8 | 21.9 |
| Developing economies | 18,884 | 28,769 | 6.3 | 8.4 |
| Market economies | 15,905 | 23,581 | 8.0 | 10.3 |
| CPE | 2,979 | 5,188 | 2.9 | 4.7 |

a/ Oil equivalent.

Source: Data supplied by FAO; calculations UNIDO secretariat.

The relative contribution of vegetable oils and fats to total fat consumption shown in table 4.2 indicates that the share of vegetable oils and fats has increased in recent years. However, very different patterns are observed across economic groupings. Among the developing countries, 70-90 per cent of apparent consumption is of vegetable origin, while in the developed countries and centrally planned economies it is only 40-70 per cent.[56]

55/ Japan being an exception because its per capita consumption of 19 kg/year is still relatively low.

56/ With the exception of Japan (82 per cent).

Table 4.2. Per capita apparent consumption of fats and oils, by type and region, 1976 and 1982[a/]

| | Total Fats and oils per capita (kg/year) | | Share of vegetable oils and fats (%) | | Rate of per capita growth 1976-1982 | | |
|---|---|---|---|---|---|---|---|
| | 1976 | 1982 | 1976 | 1982 | Vegetable | Animal | Total |
| World | 11.8 | 13.5 | 68 | 72 | 3.3 | ... | 2.3 |
| North America | 33.8 | 36.5 | 66 | 70 | 2.3 | -0.9 | 1.3 |
| Western Europe | 31.0 | 32.6 | 62 | 61 | 0.5 | 1.2 | 0.8 |
| Japan | 16.6 | 19.3 | 74 | 82 | 4.3 | -3.4 | 2.5 |
| Other developed | 15.9 | 17.6 | 48 | 42 | 0.8 | 4.4 | 2.8 |
| CPE Europe | 20.8 | 21.9 | 53 | 53 | 0.9 | 0.8 | 0.9 |
| Latin America | 13.0 | 15.8 | 69 | 73 | 4.2 | 1.2 | 3.3 |
| Tropical Africa | 8.1 | 9.6 | 90 | 92 | 3.2 | ... | 2.9 |
| North Africa and West Asia | 13.2 | 15.1 | 73 | 77 | 3.0 | ... | 2.3 |
| South Asia | 5.4 | 7.0 | 81 | 83 | 4.7 | 3.1 | 4.4 |
| CPE Asia | 2.9 | 4.7 | 69 | 82 | 12.2 | 2.0 | 9.2 |

a/ Oil equivalent.

Source: Data supplied by FAO; calculations UNIDO secretariat.

Although per capita consumption of vegetable oils and fats is growing at a faster rate than that of animal fats in many parts of the world,[57] the underlying causes vary. The negative growth rates in the per capita consumption of animal fats detected in North America and Japan can be interpreted as a response to health campaigns and movements directed to seeking a reduction in the amounts of saturated fats in the diets of affluent societies.[58]

With regard to oil meals and cakes, consumption was concentrated in the developed world (71 per cent of the world total in 1982) but the growth rates in the developing countries were two to three times as great as in the developed market economies, with soya meal playing a dominant role. These large meal consumption growth rates coincide with very large growth rates found in the animal feed industry of the developing world (see table 3.6).

## 4.2 Regional consumption

Tables 4.3 and 4.4 show the regional distribution of apparent consumption of the vegetable oils and fats and cakes and meals respectively. Developing market and Asian centrally planned economies accounted for more than half of the world consumption in 1982, the highest shares corresponding to South-East Asia, Latin America and Asian centrally planned economies. In the case of meals, the Asian centrally planned economies maintained their share of apparent consumption, but the developing market economies' share was less than half that for fats and oils. However, growth rates of apparent consumption of both oils and meals were generally two to three times greater than those of

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57/ With the exception of Australia, New Zealand, South Africa and Western Europe.

58/ This difference in growth rates between developing and developed countries agrees with that projected by FAO for 1985 and is similar to that estimated by the World Bank for the period 1980-1985. - FAO, Committee on Commodity Problems, Intergovernmental Group on Oilseeds, Oils and Fats, thirteenth session, "Oilseeds, fats and oils, oilcakes and meals: supply, demand and trade projections, 1985", Rome, February 1979. The World Bank, Price prospects for major primary commodities, Vol. II, Food products and fertilizers, July 1982.

Table 4.3. Apparent consumption of vegetable oils and fats (oil equivalent) by region, 1976-1982 (thousand metric tons)

| Region | 1976 | | 1978 | | 1980 | | 1982 | | Average annual growth rate 1976-1982 (%) |
|---|---|---|---|---|---|---|---|---|---|
| | Apparent consumption | Share (%) | Apparent consumption | Share (%) | Apparent consumption | Share (%) | Apparent consumption | Share (%) | |
| Developed market economies | 14,230 | 43.5 | 14,050 | 40.1 | 16,237 | 40.2 | 16,419 | 37.3 | 2.4 |
| European centrally planned economies | 4,049 | 12.4 | 4,100 | 11.7 | 4,243 | 10.5 | 4,504 | 10.2 | 1.8 |
| Developing market economies | 12,533 | 38.3 | 14,890 | 42.5 | 17,128 | 42.4 | 19,298 | 43.8 | 7.5 |
| Africa, South of Sahara | 2,099 | 6.4 | 2,366 | 6.7 | 2,681 | 6.6 | 3,096 | 7.0 | 6.7 |
| North Africa and West Asia | 2,028 | 6.2 | 2,313 | 6.6 | 2,726 | 6.7 | 2,963 | 6.7 | 6.5 |
| South and South East Asia | 5,441 | 16.6 | 6,664 | 19.0 | 7,526 | 18.6 | 8,858 | 20.1 | 8.5 |
| Latin America | 2,965 | 9.1 | 3,547 | 10.1 | 4,195 | 10.4 | 4,381 | 9.9 | 6.7 |
| Asian centrally planned economies | 1,902 | 5.8 | 2,019 | 5.8 | 2,809 | 6.9 | 3,842 | 8.7 | 12.4 |
| World total | 32,713 | 100.0 | 35,058 | 100.0 | 40,420 | 100.0 | 44,063 | 100.0 | 5.1 |

Source: Data supplied by FAO; UNIDO secretariat calculations.

Table 4.4. Apparent consumption of vegetable cakes and meals (100 per cent protein) by region, 1976-1982 (thousand metric tons)

| Region | 1976 | | 1978 | | 1980 | | 1982 | | Average annual growth rate 1976-1982 (%) |
|---|---|---|---|---|---|---|---|---|---|
| | Apparent consumption | Share (%) | Apparent consumption | Share (%) | Apparent consumption | Share (%) | Apparent consumption | Share (%) | |
| Developed market economies | 18,204 | 61.7 | 19,607 | 60.7 | 24,038 | 61.9 | 23,345 | 58.4 | 4.2 |
| European centrally planned economies | 4,552 | 15.4 | 4,509 | 14.0 | 5,012 | 12.9 | 5,338 | 13.3 | 2.7 |
| Developing market economies | 4,730 | 16.0 | 6,146 | 19.0 | 7,187 | 18.5 | 7,890 | 19.7 | 8.9 |
| Africa, South of Sahara | 358 | 1.2 | 419 | 1.3 | 499 | 1.3 | 518 | 1.3 | 6.4 |
| North Africa and West Asia | 588 | 2.0 | 964 | 3.0 | 864 | 2.2 | 1,140 | 2.8 | 11.7 |
| South and South East Asia | 2,091 | 7.1 | 2,571 | 8.0 | 2,752 | 7.1 | 3,578 | 8.9 | 9.4 |
| Latin America | 1,693 | 5.7 | 2,192 | 6.8 | 3,072 | 7.9 | 2,654 | 6.6 | 7.8 |
| Asian centrally planned economies | 2,017 | 6.8 | 2,048 | 6.3 | 2,579 | 6.6 | 3,433 | 8.6 | 9.3 |
| World total | 29,503 | 100.0 | 32,309 | 100.0 | 38,815 | 100.0 | 40,007 | 100.0 | 5.2 |

Source: Data supplied by FAO; UNIDO secretariat calculations.

the developed market economies. The reasons for this are likely to include both low absolute levels of consumption as well as recent policy shifts in the developing countries designed to encourage both exports and domestic consumption.

The great disparity in per capita apparent consumption levels of visible fats and oils between developed and developing countries would be even greater if the invisible fats, i.e. those contained in other foods (milk, cheese and meat) were included, because livestock products are generally too expensive for large population groups in the developing countries.

## 4.3 Levels of income and patterns of apparent consumption; projection of future consumption

It is widely known that income plays a significant role in determining the composition of diets in general. Figure 4.1 shows that this relationship also holds true generally for apparent consumption of fats and oils.

Previous studies of both nutrional and economic character have shown that this consumption of fats and oils tends to increase with rising incomes approaching saturation levels at around 30 kg/cap/per annum.[59/] When applied to 1980 data for 48 countries, this model seems to hold very well for developing as well as developed countries (see Figure 4.1 and annex 1b for description of the econometric analysis). Certain producing countries such as Malaysia and Senegal, however, show considerably higher consumption levels than one would expect solely on a per capita income basis. Similarly, a few countries show lower consumption levels than those predicted by the simple income model. The deviations are probably best explained by inaccuracies in the data or by supply factors and dietary customs.

The relationship between consumption of fats and oils and per capita income is (statistically) sufficiently stable to allow us to use it for forecasting purposes. Applying standard assumptions regarding population and

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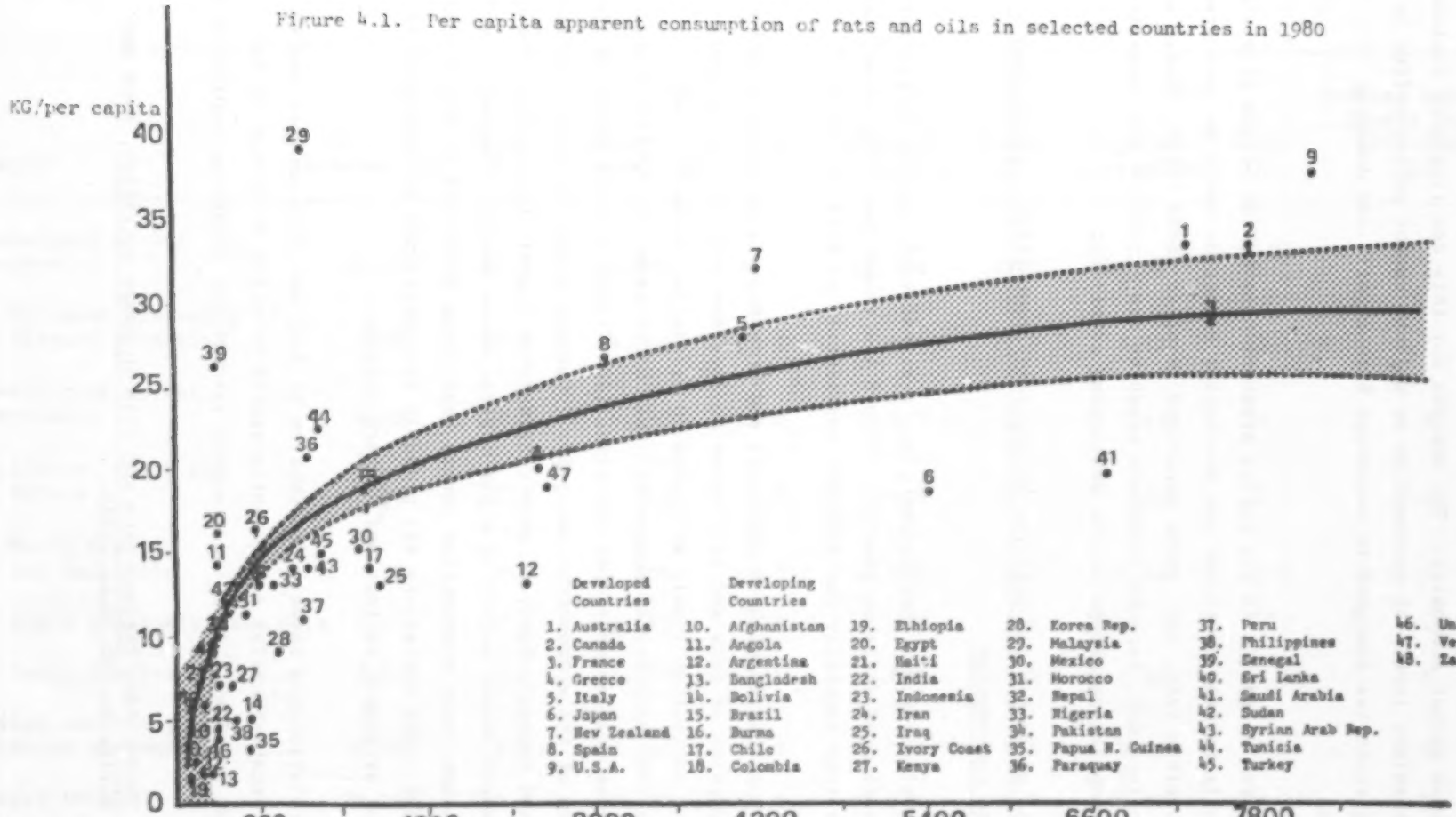
59/ Ibid., FAO, Dietary fats and oils in human nutrition, Food and Nutrition Series No. 20, Rome, 1980.

Figure 4.1. Per capita apparent consumption of fats and oils in selected countries in 1980




| Developed Countries | | Developing Countries | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. Australia | 10. | Afghanistan | 19. | Ethiopia | 28. | Korea Rep. | 37. | Peru | 46. United Rep. Tanzania |
| 2. Canada | 11. | Angola | 20. | Egypt | 29. | Malaysia | 38. | Philippines | 47. Venezuela |
| 3. France | 12. | Argentina | 21. | Haiti | 30. | Mexico | 39. | Senegal | 48. Zaire |
| 4. Greece | 13. | Bangladesh | 22. | India | 31. | Morocco | 40. | Sri Lanka | |
| 5. Italy | 14. | Bolivia | 23. | Indonesia | 32. | Nepal | 41. | Saudi Arabia | |
| 6. Japan | 15. | Brazil | 24. | Iran | 33. | Nigeria | 42. | Sudan | |
| 7. New Zealand | 16. | Burma | 25. | Iraq | 34. | Pakistan | 43. | Syrian Arab Rep. | |
| 8. Spain | 17. | Chile | 26. | Ivory Coast | 35. | Papua N. Guinea | 44. | Tunisia | |
| 9. U.S.A. | 18. | Colombia | 27. | Kenya | 36. | Paraguay | 45. | Turkey | |

..... = 95 % confidence level

——— = $1378.130-1703.562\left(\frac{1}{GNP_{pc}}.05\right)$

income growth (see annex 1b) the resulting projected consumption of all fats and oils by region is derived using the estimated model of annex 1b. By further applying the shares of vegetable oils and fats in total consumption from table 4.2 (for 1982), we arrive at the projected consumption of vegetable oils and fats shown in table 4.5.

In table 4.5, the consumption figures for 1980 are those estimated by the model. These compare well with the actual figures, except for Japan for which the model overestimates the consumption (table 4.3 and World Bank data)[60/] and North America for which the estimated per capita figure is lower than that reported for 1980. Also, compared to the latest FAO figures, the People's Republic of China's estimated consumption is high (and therefore also CPE Asia's). Nonetheless, at a regional aggregation level, the reference base is good and the projections can be assumed to have some validity, provided the underlying economic causalities do not change radically.

The projected 1990 consumption levels in table 4.5 can be compared to those derived by the World Bank.[61/] Again the agreement is very close, in particular for the developed countries and Asia. For Japan, our projection is high whereas it is somewhat low for the European CPE's, compared to the corresponding World Bank projections.

For the year 2000, our present projection of world total consumption is clearly higher than the one presented by UNIDO in 1977.[62/] This reflects an increased emphasis on vegetable oils and fats in human diets. In sum, the projections at an aggregate regional level presented in table 4.5 appear to be reasonable, although they are based on a very simple economic model.

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60/ The World Bank, Price Prospects for Major Primary Commodities, Vol. II; Food Products and Fertilizers, Washington D.C., 1982, annex table 3 (restricted distribution).

61/ Ibid.

62/ Draft world-wide study on the vegetable oils and fats industry: 1975-2000, UNIDO/ICIS.46, Vienna, 1977. p. 90.

Table 4.5. Estimated apparent consumption of vegetable oils and fats by region, 1980, 1990 and 2000[a/]

| UNITAD region | 1980 Kg/cap | 1980 Total thousand tons | 1990 Kg/cap | 1990 Total thousand tons | 2000 Kg/cap | 2000 Total thousand tons |
|---|---|---|---|---|---|---|
| 1. North America | 20.4 | 5,027 | 21.2 | 5,802 | 22.0 | 6,582 |
| 2. West Europe | 16.5 | 6,187 | 16.9 | 6,570 | 17.4 | 6,895 |
| 3. CPE Europe | 12.1 | 4,564 | 13.3 | 5,396 | 14.5 | 6,253 |
| 4. Japan | 22.2 | 2,580 | 24.6 | 3,025 | 26.9 | 3,479 |
| 5. Other developed | 10.3 | 485 | 10.7 | 626 | 11.0 | 804 |
| 6. Latin America and Caribbean | 13.8 | 5,046 | 15.2 | 6,990 | 16.7 | 9,453 |
| 7. Tropical Africa | 10.0 | 3,311 | 10.7 | 4,823 | 11.3 | 6,978 |
| 8. North Africa and West Asia | 13.9 | 3,247* | 14.8 | 4,754 | 16.0 | 6,607 |
| 9. South Asia | 4.6 | 4,354 | 5.4 | 6,279 | 6.4 | 8,791 |
| 10. South-East Asia and Oceania | 11.7 | 3,638 | 13.0 | 5,912 | 15.5 | 8,260 |
| 11. CPE Asia | 6.5[b/] | 7,013 | 7.9 | 9,048 | 10.0 | 12,831 |
| World total | 10.2 | 45,454 | 11.3 | 59,224 | 12.6 | 76,933 |

a/ Included: edible soft oils, coconut and palm kernel and palm oil.

b/ The estimated per capita consumption in CPE Asia is much higher than the 3.0 kg/capita reported by FAO for the People's Republic of China in 1980. Therefore, the projected regional total may be too large.

Source: UNIDO secretariat projections (see annex 1b).

At the country level there exists a great deal of variability in the association between income and apparent consumption of fats and oils because the experience of individual countries may be shaped by a number of factors not directly related either to income or to apparent consumption. This will be illustrated by a brief and somewhat speculative discussion of the patterns observed in figure 4.2.

Figure 4.2 shows the average change in per capita total fat apparent consumption against average change in per capita income between 1971 and 1980 for 53 individual countries.[63/] Quadrant I contains those countries in which the average change over the period was positive for both variables; quadrant II shows those countries that have experienced positive growth in per capita income but negative growth in per capita apparent consumption; quadrant III contains only Ghana and Peru, which have experienced negative growth rates in both variables over the period; and quadrant IV includes countries which had a positive rate of growth of per capita apparent consumption of total fats and oils even in the face of a negative change in their per capita income.

The majority of the countries fall in quadrant I, showing a positive correlation between income growth and consumption growth. But regardless of income growth, the growth in consumption is less for these countries with already high consumption levels. This strengthens the assumption behind the proejctions above, namely that growing income will cause growing consumption until saturation starts to set in.

The ten countries located in quadrant II show a decrease in growth of per capita apparent consumption in spite of the positive growth registered in income. The factors that could account for this situation include an increased agricultural instability, an uneven distribution of the additional income and/or the effects of national food promotion policies. These might be

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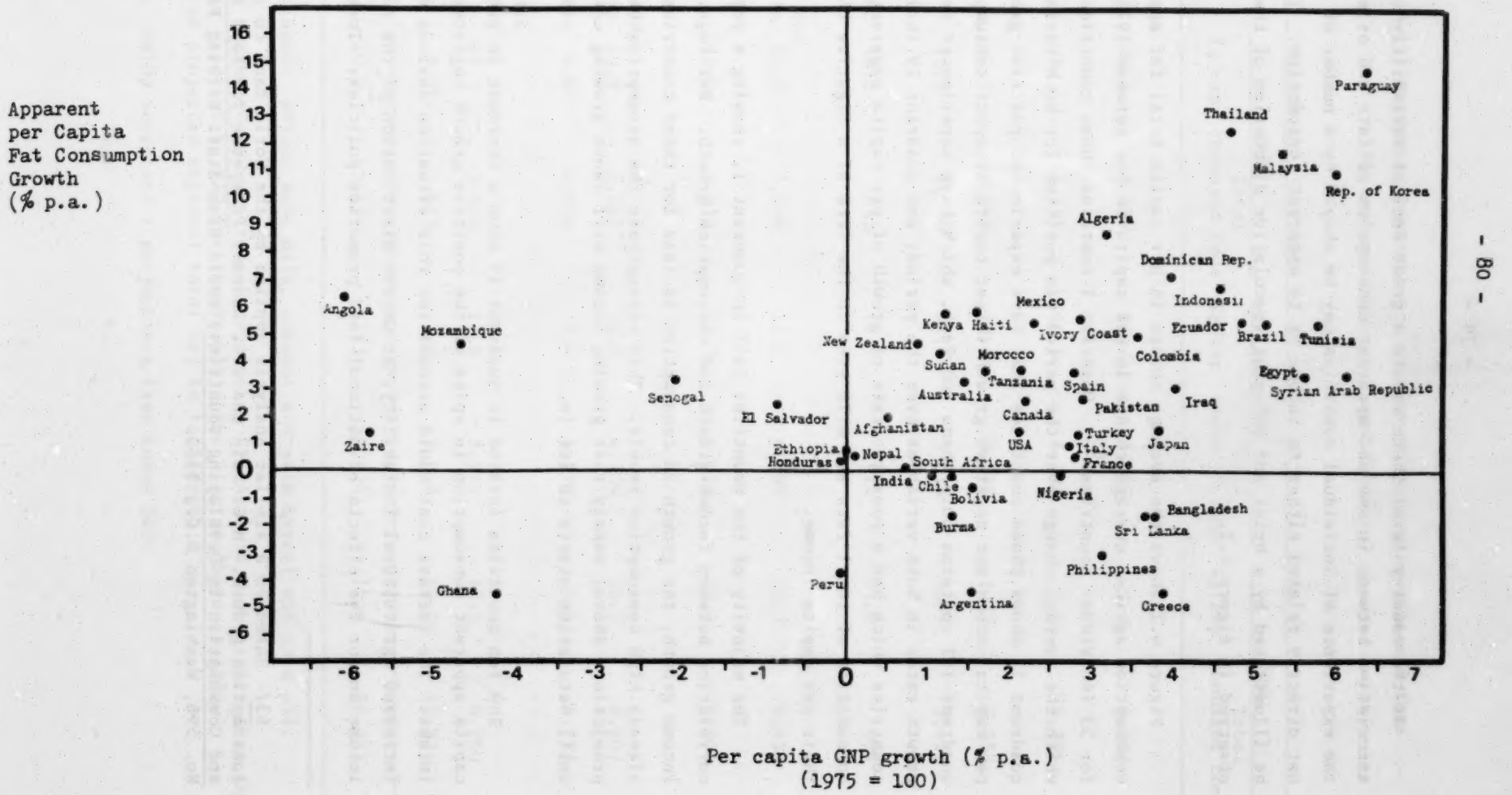
63/ Based on a similar analysis applied by the World Bank to food consumption growth. M.C. Dale and R.C. Duncan, Prospects for Food Production and Consumption in Developing Countries, World Bank Staff Working Papers No. 596, Washington D.C., 1983.

Real Income and Fat Consumption Growth in Selected Countries, 1971 - 1980



very interesting countries for more detailed study of consumption patterns. However, for present purposes they at least suggest that, at the country level, the positive correlation between income and consumption cannot always be expected to lead to consumption growth, even in countries with very low levels of apparent consumption, such as Burma, Bolivia and Sri Lanka (5 to 7 kg/cap/year) (see figure 4.1).

The position of the six countries in quadrant IV may be a reflection of food policies favouring access of low income groups to basic food commodities. Finally, Peru and Ghana the only countries found in quadrant III, may be examples of the effects of the absence or inefficiency of such policies under adverse economic conditions. A comparative analysis of the countries found in quadrants III and IV might provide some useful insights into the factors affecting changes in per capita apparent consumption of fats and oils.

The above discussion is intended to pose some hypotheses of what factors might influence patterns of apparent consumption. Mainly, however, it strongly suggests that in developing countries, it is not safe to assume that increases in income will always translate into increases in fat consumption.

## 4.4 Self-sufficiency in oils and fats

Since in developing countries edible oils are frequently considered within the group of basic foods, governments are often involved in securing an adequate supply of oils and fats at reasonable prices. Therefore, in the majority of net oil and fats importing countries, a reduction of dependence on imported edible oils is searched for, both for strategic and balance of payment reasons.

The share of gross imports of edible oils and fats in total apparent consumption of fats can be used as a measure of the degree of dependence on imports. The higher the rates, the greater the dependence or conversely, the smaller the degree of self-sufficiency. In order to assess the present level of dependence on imported fats and oils in developing countries, the

dependency ratio was estimated for the year 1976 and 1982 for those countries with an oils and fats deficit. Countries were classified into the following three groups:

| | Dependency ratio |
|---|---|
| Group I | Higher than 70 per cent |
| Group II | Between 40 and 70 per cent |
| Group III | Lower than 40 per cent |

The results obtained are presented in table 4.6 together with per capita apparent consumption figures[64/]. Together with the previous results in this chapter, they offer some further insight into the reasons for recent changes in consumption levels.

An analysis of the table shows a general tendency towards increased dependency ratios over time with the exception of Bolivia in group II, Ecuador, Tanzania and Ghana in group III. Particularly noticeable are the changes towards greater dependency detected in Nigeria, Angola, Thailand and Mozambique in group III.

An analysis of the position of these countries in figure 4.2 indicates that while the increase in dependency in Thailand corresponds to a normal increase in consumption with increased income, in Angola and Mozambique increases in consumption and dependency appear to be mainly the consequence of government food consumption policies. In the case of Nigeria, per capita consumption levels were barely maintained during the period and the observed increased dependence is due entirely to population growth. Ecuador and Tanzania registered a real decrease in dependency with increasing levels of consumption, while in Ghana and Bolivia, lower levels of dependency were obtained at the expense of lower levels consumption.

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64/ Total edible fat per capita apparent consumption.

Table 4.6. Level of dependence on imported oils and fats in vegetable oil deficit countries

| Countries | Dependency ratio*/ 1976 | Dependency ratio*/ 1982 | Level of total fat apparent per capita consumption 1982 (kg/yr) |
|---|---|---|---|
| Group I[a]/ | | | |
| 1. Saudi Arabia | 97.4 | 100.0 | 16-20 |
| 2. Algeria | 87.1 | 96.2 | 20 |
| 3. Republic of Korea | 82.7 | 94.7 | 11-15 |
| 4. Dominican Republic | 80.9 | 93.0 | 11-15 |
| 5. Iraq | 76.7 | 91.7 | 11-15 |
| 6. Morocco | 80.1 | 89.1 | 11-15 |
| 7. Haiti | 86.1 | 84.4 | 6-10 |
| 8. Kenya | 86.2 | 78.2 | 6-10 |
| 9. Venezuela | 69.2 | 77.6 | 20 |
| 10. Egypt | 73.7 | 76.7 | 20 |
| Group II[b]/ | | | |
| 1. Bangladesh | 68.1 | 69.0 | 5 or less |
| 2. Tunisia | 7.9 | 67.0 | 20 |
| 3. Colombia | 52.2 | 64.5 | 11-15 |
| 4. El Salvador | 54.5 | 63.6 | 11-15 |
| 5. Bolivia | 77.8 | 60.0 | 11-15 |
| 6. Pakistan | 40.6 | 59.1 | 11-15 |
| 7. Chile | 58.1 | 53.8 | 16-20 |
| 8. Mexico | 21.2 | 52.8 | 11-15 |
| Group III[c]/ | | | |
| 1. Angola | 18.3 | 38.0 | 16-20 |
| 2. Syria | 26.9 | 36.2 | 20 |
| 3. Ecuador | 56.0 | 34.2 | 16-20 |
| 4. Mozambique | 13.2 | 33.2 | 6-10 |
| 5. Peru | 34.5 | 32.5 | 11-15 |
| 6. Thailand | 23.5 | 32.4 | 5 or less |
| 7. Honduras | 37.5 | 32.3 | 6-10 |
| 8. Nigeria | 6.8 | 31.1 | 16-20 |
| 9. Turkey | 25.7 | 23.8 | 11-16 |
| 10. India | 3.9 | 21.1 | 6-10 |
| 11. Tanzania | 24.0 | 21.1 | 6-10 |
| 12. Uruguay | 10.5 | 14.6 | 11-15 |
| 13. Ethiopia | 4.8 | 10.4 | 5 or less |
| 14. Ghana | 22.7 | 9.9 | 6-10 |
| 15. Nepal | - | 6.1 | 5 or less |
| 16. China | 3.7 | 4.2 | |

* $\frac{\text{Gross imports of total edible fats and oils}}{\text{Total apparent consumption}} \times 100 = \text{Dependency ratio}$

a/ Dependency ratio - greater than 70 per cent
b/ Dependency ratio - between 40-70 per cent
c/ Dependency ratio - less than 40 per cent

Source: Oil World, UNIDO secretariat caluclations.

It is also interesting to note that no oil palm producing countries are classified in group I and that Nigeria, a large oil palm producer, and Colombia, Ecuador and Peru (three small oil palm producers), fall into groups with lower dependency ratios. This could be taken as an illustration of the possibilities that palm oil offers to certain tropical countries for improving their level of self-sufficiency in vegetable oils and fats.

Low levels of self-sufficiency in edible oils and fats are neither country-income specific nor directly correlated with levels of fat consumption. Each one of the three groups contains countries with very different levels of economic development and of fats and oils consumption. Such are the cases of Saudi Arabia and Haiti in group I, Mexico and Bangladesh in group II and Nigeria and Nepal in group III.

The results of this analysis also illustrate that in spite of past and present efforts made by governments to improve levels of self-sufficiency in edible oils and fats, there is a large number of countries that import a sizeable proportion of their requirements. A comparison of imports of the main importer developing countries (15 countries that together account for 75 per cent of world imports of fats and oils) and the rates of growth of their fats and oils apparent consumption indicates that, during the last 10 years, most of the increase in consumption has come from imports, the rate of growth of imports being several times higher than that of consumption (table 4.7).

The possibility of avoiding imports in the short term (3-5 years) may not be attainable for the majority of countries even if the long term objective is to achieve self-sufficiency. Hence, medium term planning (3-5 years) of import requirements could help governments in securing adequate supplies of vegetable oils at reasonable prices by opening the option of importing cheaper oils and avoiding large fluctuations in oil availability on the internal markets which often occur in edible oil importing countries. Moreover, the medium term planning of imports will increase the possibilities of trade among developing countries as has been pointed out by FAO[65/] and was discussed in chapter 3.

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65/ FAO CCP: OF 80/4, Rome, February 1980, Committee on Commodity Problems, "Expanding Trade in Fats and Oils Among Developing Countries: Opportunities, Constraints and Policy Needs".

Table 4.7. Total fats and oils imports and apparent consumption in selected developing countries, 1970-1980[a/]

| | Imports | | | Consumption | |
|---|---|---|---|---|---|
| | Average 1970-1971 (thousand tons) | Average 1979-1980 (thousand tons) | Growth rate 1970-1980 (per cent p.a.) | kg/cap. 1980 | growth 1971-80 |
| Algeria | 110 | 320 | 12.6 | 18.2 | 8.4 |
| Bangladesh | 120 | 150 | 2.5 | 2.3 | -1.77 |
| China | 180 | 660 | 15.5 | 3.7 | 3.56 |
| Colombia | 60 | 190 | 13.7 | 13.0 | 5.11 |
| Cuba | 180 | 190 | 0.6 | 22.3 | 0.15 |
| Egypt | 200 | 500 | 10.7 | 16.0 | 3.74 |
| India | 170 | 1,290 | 25.3 | 6.8 | 1.78 |
| Iran | 140 | 420 | 13.0 | 13.0 | 6.46 |
| Iraq | 100 | 170 | 6.1 | 13.2 | 3.13 |
| Republic of Korea | 100 | 310 | 13.4 | 9.0 | 13.66 |
| Mexico | 60 | 410 | 23.8 | 15.5 | 5.59 |
| Morocco | 110 | 220 | 8.0 | 12.0 | 3.25 |
| Nigeria | - | 280 | | 14.4 | 0.00 |
| Pakistan | 140 | 450 | 13.9 | 10.3 | 3.14 |
| Venezuela | 60 | 220 | 15.5 | 19.1 | 5.80 |

a/ Including the oil equivalent of oilseeds but excluding quantities subsequently re-exported.

Source: Data supplied by FAO; UNIDO secretariat calculations.

Clearly, the per capita apparent consumption of fats and oils has increased in the developing countries as a group, but not enough to narrow the gap in absolute terms that exists between them and a theoretical level of adequate consumption. Moreover, high population increases are still found in the developing countries.[66/] Therefore, the potential for increased consumption in developing countries remains large. But in the industrialized countries further increases are limited.

This also is evident in the very different annual consumption growth rates that are implicit in the projections for developing and developed countries for the periods 1980-1990 and 1990-2000, 3.6 and 3.4 per cent, and 1.3 and 1.1 per cent, respectively.[67/] However, the discussion above concerning income growth and consumption growth indicates that it is not safe to assume that increases in income will always lead to increases in fat consumption. Hence, it may be of importance to monitor more carefully consumption patterns and their susceptibility to internal and external factors to be able to make more accurate projections on a country level.

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66/ Hancock, F. Richard, "The changing role of developing countries in the world economy of fats and oils; effects on the EEC", Chemistry Industry, 3 July 1982, pp. 439-442.

67/ These growth rates are somewhat lower than those projected by the World Bank. The World Bank, report number 814/82, Price Prospects for Major Primary Commodities, Vol. II, Food Products and Fertilizers, July 1982.

## 5. PROCESSING OF OILSEEDS WITH PARTICULAR REFERENCE TO DEVELOPING COUNTRIES

This section is based on all available information on the crushing and refining capacities of some 72 countries. The detailed data are available from the UNIDO secretariat; summary statistics by region will be found in the Statistical Digest on Vegetable Oils and Fats Industry to be published as Volume 2 of this study. In general, data on crushing are more widely available than that on refining, and some regions, notably Asia, published more data than others, in particular Central America.[68/]

### 5.1 Global overview of crushing

In this report, the term crushing is applied to both the mechanical and chemical separation of the oil from seeds, copra or fruits. This section describes the basic features of the global crush by country, by region, by seed, and over time. It is based on the actual crush figures for 51 countries.[69/]

Total global crush in 1982 amounted to 159.4 million tons,[70/] of which more than one half was in the developing countries. Between 1976 and 1982, an increase of 6.4 percentage points in the participation of developing countries was observed (table 5.1).

In the worlds crushings, soya beans play a dominant role,[71/] followed by oil palm, cottonseed, sunflower seed and rapeseed. Groundnuts account for only 4 per cent of total crushings, while they represented 10 per cent of total oilseed production. This difference is probably explained by the large proportion of groundnuts that goes to direct human consumption.

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68/ The description and analysis of chapters 5-8 is largely based on a work undertaken by TDRI for the present study.

69/ More detailed information will be found in the Statistical Digest on Vegetable Oils and Fats Industry to be published as Volume 2 of this study.

70/ Including oil seeds, copra and oil palm.

71/ As they did in production, see table 2.1.

Table 5.1. Crushing of selected oilseeds and copra by economic grouping

| Seed | Developing countries[a] 1976 (thousand tons) | Developing countries[a] 1976 (per cent) | Developing countries[a] 1982 (thousand tons) | Developing countries[a] 1982 (per cent) | Developed market economies 1979 (thousand tons) | Developed market economies 1979 (per cent) | Developed market economies 1982 (thousand tons) | Developed market economies 1982 (per cent) | Centrally planned economies 1976 (thousand tons) | Centrally planned economies 1976 (per cent) | Centrally planned economies 1982 (thousand tons) | Centrally planned economies 1982 (per cent) | World 1976 (per cent) | World 1982 (per cent) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Soya beans | 11,868 | 23.2 | 22,659 | 27.4 | 38,980 | 80.5 | 49,814 | 78.4 | 2,378 | 18.8 | 2,518 | 19.2 | 47.5 | 47.0 |
| Oil palm[b] | 12,580 | 24.6 | 22,762 | 27.5 | - | - | - | - | - | - | - | - | 11.2 | 14.3 |
| Cottonseed | 9,441 | 18.5 | 12,262 | 14.8 | 3,147 | 6.5 | 4,739 | 7.4 | 4,002 | 31.6 | 4,151 | 31.7 | 14.8 | 13.3 |
| Rapeseed | 3,354 | 6.6 | 7,068 | 8.5 | 2,345 | 4.9 | 4,807 | 7.5 | 1,142 | 9.0 | 966 | 7.4 | 6.1 | 8.1 |
| Sunflower seed | 1,702 | 3.3 | 4,491 | 5.4 | 1,427 | 3.0 | 3,243 | 5.1 | 5,084 | 40.2 | 5,444 | 41.5 | 7.3 | 8.3 |
| Groundnuts | 6,348 | 12.4 | 6,589 | 8.0 | 1,085 | 2.2 | 448 | 0.7 | 9 | 0.1 | 4 | 0.0 | 6.6 | 4.4 |
| Copra | 3,909 | 7.7 | 4,233 | 5.1 | 1,086 | 2.2 | 357 | 0.6 | 20 | 0.2 | 16 | 0.1 | 4.5 | 2.9 |
| Palm kernels | 829 | 1.6 | 1,539 | 1.9 | 301 | 0.6 | 114 | 0.2 | 4 | 0.0 | - | - | 1.0 | 1.0 |
| Sesame seed | 1,062 | 2.1 | 1,127 | 1.4 | 42 | 0.1 | 45 | 0.1 | 9 | 0.1 | 13 | 0.1 | 1.0 | 0.7 |
| Total crushing | 51,093 | 100.0 | 82,730 | 100.0 | 48,413 | 100.0 | 63,567 | 100.0 | 12,648 | 100.0 | 13,112 | 100.0 | 100.0 | 100.0 |
| Regional share or world crushing (%) | | 45.5 | | 51.9 | | 43.2 | | 39.9 | | 11.3 | | 8.2 | | |
| Total world crushing (thousand tons) | | | | | | | | | | | | | 112,154 | 159,409 |

a/ "other countries" are included under Developing Countries

b/ Estimated from palm oil production according to J.A. Cornelius, TPI, G149, 1983.

Note: The oil palm fruit must be crushed at the site within 24 hours of harvesting. The crush is therefore not recorded but must be inferred from the resulting production of palm oil as has been done in table 2.6.

Source: Oil World; UNIDO secretariat calculations.

Regionally, the major components of the crush in the developing countries as a whole are oil palm and soya beans. In the developed market economies, soya bean dominates. Although sunflower seed and cottonseed are still the most important materials for crushing in the centrally planned economies, soya beans also play an important role representing one fifth of their total crushings (table 5.1).

Although total world crushings increased by 47 million tons during the period 1976-1982, the relative contribution of the different raw materials remained fairly stable. Notably, however, oil palm and rapeseed increased their shares, largely at the expense of soya beans. Genetic developments in the field are largely responsible for these shifts.

However, interesting shifts in the regional share of the crush of a particular oilseed have occurred. For example, Latin America increased its share of the world soya bean crush during the period 1979-1982 while the large share of the developed market economies fell. This is mainly due to the huge growth in Brazil. Another significant development is the considerably increased shares which Malaysia now commands in the palm kernel and oil palm crushes - 49 per cent of the former and 62 per cent in the latter in 1982. This came at the expense of Africa and the EEC (for palm kernel). Notable are also the People's Republic of China's growth in the shares of sesame seed and groundnut crush, the loss of share in groundnut crush by Brazil and Argentina, and the shift of rapeseed crush towards the developing countries in general.

The country with the largest average crush is easily the United States with 33.8 million tons or 21.6 per cent of the global crush in 1981-1982. The next largest countries are Brazil (with 14.4 million tons or 9.2 per cent of global crush), the People's Republic of China (with 14.0 million tons or 8.9 per cent) and the USSR (with 9.4 million tons or 6.0 per cent). The EEC accounted for a further 9.2 per cent of the global crush.

Table 5.2 presents figures derived for 13 of the major oil palm crushing countries from FAO production data. Palm oil production in these countries represented 94 per cent of total world palm oil production. Of this, 71 per cent is produced in Asia and 23 per cent in Africa.

Table 5.2. Derived oil palm crush 1981-1982

| | 1981 | 1982 |
|---|---|---|
| | Crush a/ (thousand tons) | Crush a/ (thousand tons) |
| Africa | | |
| Benin | 70 | 61 |
| Cameroon | 284 | 300 |
| Ivory Coast | 534 | 600 |
| Nigeria | 1,452 | 1,316 |
| Zaire | 369 | 365 |
| Latin America | | |
| Brazil | 60 | 68 |
| Colombia | 321 | 360 |
| Ecuador | 196 | 232 |
| Asia | | |
| China | 320 | 340 |
| Indonesia | 2,967 | 3,395 |
| Malaysia | 11,298 | 14,044 |
| Papua New Guinea | 184 | 312 |
| Salomon Is. | 72 | 77 |
| Other countries | 1,220 | 1,292 |
| Total | 19,347 | 22,762 |

a/ Crush was estimated as oil production multiplied by a factor of 4 according to J.A. Cornelius, Processing of Oil Palm Fruit and its Products, TPI, G149, 1983.

Source: Oil World, UNIDO secretariat calculations.

In Asia and Africa, oil palm is by far the major oil crop by size of crush. In Asia, the tonnage crushed is nearly four times that of the next most commonly crushed seed, copra, while in Africa it is nearly five times that of the next seed, cottonseed. In Latin America, oil palm contribution is still low but recent developments and policy measures taken in the Andean Pact and Central American countries could change its role in the coming years.

In addition to the observations already made above, an analysis of the oil crops crushed during 1982 at the regional and country level shows (see table 5.3):

- Three oil crops (soya beans, oil palm and cottonseed) contributed 75 per cent of the 1982 global crush as shown in table 5.3.

- A relative large number of countries in Asia, Africa and Latin America made important contributions to the global crush.

- Crushing of cottonseed is less region- and country-specific than other oilseeds, the major crushers being the United States, the USSR and the People's Republic of China.

- Rapeseed is not region-specific, Asian countries being the largest crushers, followed by the EEC.

- The USSR is the largest sunflower crusher followed by Argentina and the People's Republic of China.

- Asia is the largest crusher of groundnuts, the overwhelming share being in India (47 per cent) and a large share in the People's Republic of China (19 per cent).

- Copra crushing is dominated by the Asian countries which accounted for 87 per cent of the total copra crush, with two dominant countries, the Philippines (45 per cent) and Indonesia (22 per cent).

Table 5.3. Main crushers by regions and commodities, 1982

| Commodity | Asia, Africa and Latin America | Europe and North America | Total crush million tons 1982 | (%) |
|---|---|---|---|---|
| Soya | Brazil (16)<br>People's Republic of China (6) | United States (38)<br>EEC (16) | 75.0 | 47.0 |
| Oil palms | Malaysia (62)<br>Indonesia (15)<br>Nigeria (6)<br>Ivory Coast (3)<br>Zaire (2)<br>People's Republic of China (2) | - | 22.8 | 14.3 |
| Palm kernels | Malaysia (49)<br>Nigeria (9)<br>Indonesia (8) | EEC (6) | 1.7 | 1.0 |
| Cottonseed | People's Republic of China (18)<br>India (8)<br>Pakistan (6)<br>Brazil (5) | USSR (20)<br>United States (21) | 21.2 | 13.3 |
| Rapeseed | People's Republic of China (34)<br>India (16)<br>Japan (9) | EEC (18) | 12.8 | 8.1 |
| Sunflower | Argentina (13)<br>People's Republic of China (9)<br>Turkey (4) | USSR (28) | 13.2 | 8.3 |
| Groundnuts | India (47)<br>People's Republic of China (19) | | 7.0 | 4.4 |
| Copra | Philippines (45)<br>Indonesia (22) | - | 4.6 | 2.9 |
| Sesame seeds | India (29)<br>People's Republic of China (26) | | 1.1 | 0.7 |
| Total | | | 159.4 | 100.0 |

( ) Percentage of total world crush of a given commodity.

Source: Oil World, UNIDO secretariat calculations.

- Asia is also the dominant crushing region for sesame seed, India and the People's Republic of China crushing 29 and 26 per cent of the global crush of this seed, respectively.

## 5.2 Trends in crushing

Table 5.4 shows time series data on the global crush for selected countries. The discussion that follows is based on the available information which unfortunately does not give a complete regional coverage and does not include oil palm.[72/]

The global crush has grown a great deal in recent years. This increase in global crush, however, was not uniform in all regions. The growth of crush in Asia between 1976/77 and 1981/82 was only 20.7 per cent causing Asia to loose some of its share in global crush. Figures for Malaysia show considerable growth of crush (227 per cent from 1976/77 to 1981/82) and this is largely due to increased palm kernel crush. Note, however, that oil palm crush is not included in the above figures because direct data are not available. Malaysia is known to have dramatically increased its crush of this commodity and if this were to be included, the overall picture would be even more dramatic.

The growth in Taiwan Province of China and Pakistan also exceeded the global average but, for all other Asian countries listed, the growth was less. India, which represented nearly half of total Asian crush in 1981-1982, achieved a growth of only 10.7 per cent during the period under review and it is this figure which pulls down the total regional growth. Additionally, crushing in Indonesia, a major crusher, also declined.

It should be noted that in countries such as the Philippines, growth in crushing represents a shift of policy from one of exporting whole oilseeds to one of retaining them at home for domestic crushing with the subsequent export of the oil. It does not necessarily imply increased production of oilseeds.

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72/ The oil palm fruit must be crushed at the site within 24 hours of harvesting. The crush is therefore not recorded but must be inferred from the resulting production of palm oil as has been done in table 5.2.

Table 5.4 Crushings of selected[a/] oilseeds in selected countries
(thousand tons)

| | Average 1970-71 | Average 1076-77 | Average 1981-82 | % increase 1976/77-1981/82 |
|---|---|---|---|---|
| Developing market economy countries | | | | |
| Asia | | | | |
| India | ... | 7,253 | 8,029 | 10.7 |
| Philippines | 1,016 | 1,628 | 2,133 | 31.0 |
| Pakistan | ... | 964 | 1,341 | 39.1 |
| Turkey | ... | 1,089 | 1,205 | 10.7 |
| Indonesia | ... | 1,114 | 1,063 | -4.6 |
| Taiwan | ... | 758 | 1,070 | 41.2 |
| Malaysia | ... | 296 | 968 | 227.0 |
| Republic of Korea | ... | 317 | 411 | 29.7 |
| Sri Lanka | ... | 118 | 120 | 1.7 |
| Subtotal | ... | 13,537 | 16,340 | 20.7 |
| Africa | | | | |
| Sudan | ... | 679 | 748 | 10.2 |
| Egypt | ... | 657 | 484 | -26.3 |
| Senegal | 403 | 659 | 363 | -44.9 |
| Nigeria | ... | 135 | 176[b/] | 30.4 |
| Zaire | ... | 57 | 60[b/] | 5.3 |
| Algeria | ... | 59 | 44 | -25.4 |
| Benin | ... | 55 | 27[b/] | -50.9 |
| Morocco | ... | 9 | 6 | -33.3 |
| Subtotal | ... | 2,310 | 1,908 | -17.4 |
| Latin America | | | | |
| Brazil | 3,104 | 8,618 | 14,335 | 66.3 |
| Argentina | 1,314 | 1,983 | 3,118 | 57.2 |
| Mexico | ... | 1,522 | 2,373 | 55.9 |
| Venezuela | ... | 42 | 62 | 47.6 |
| Subtotal | ... | 12,165 | 19,888 | 63.5 |
| Developing market economy countries total | ... | 28,356 | 38,622 | 36.2 |

Table 5.4 (continued)

| | Average 1970-71 | Average 1976-77 | Average 1981-82 | % Increase 1976/77-1981/82 |
|---|---|---|---|---|
| Centrally planned economies | | | | |
| People's Republic of China[c/] | ... | 6,715 | 13,232 | 97.1 |
| USSR | 8,747 | 9,937 | 9,443 | -5.0 |
| Romania[c/] | ... | 1,090 | 1,284 | 17.8 |
| Yugoslavia[c/] | ... | 493 | 591 | 19.9 |
| Hungary[c/] | ... | 216 | 567 | 62.5 |
| Poland[c/] | ... | 745 | 561 | -24.7 |
| Bulgaria[c/] | ... | 416 | 463 | 11.3 |
| Czechoslovakia[c/] | ... | 239 | 379 | 58.6 |
| GDR[c/] | ... | 328 | 330 | 0.6 |
| Subtotal | ... | 20,179 | 26,850 | 33.1 |
| Developed market economy countries | | | | |
| United States | 24,325 | 26,331 | 33,820 | 28.4 |
| West Germany | 2,885 | 4,626 | 5,129 | 10.9 |
| Japan | 3,382 | 3,687 | 5,096 | 38.2 |
| Spain | 1,669 | 2,314 | 3,779 | 63.3 |
| Netherlands | 1,601 | 1,780 | 2,953 | 65.9 |
| Canada | 918 | 1,188 | 1,998 | 68.2 |
| United Kingdom | 533 | 1,395 | 1,669 | 19.6 |
| France | 1,381 | 1,300 | 1,662 | 27.8 |
| Italy | 1,400 | 1,309 | 1,586 | 21.2 |
| Belgium/Luxembourg | 335 | 874 | 1,582 | 81.0 |
| Portugal | 156 | 350 | 547 | 56.3 |
| South Africa | ... | 344 | 486 | 41.3 |
| Greece | 244 | 292 | 474 | 62.3 |
| Norway | 252 | 256 | 348 | 35.9 |
| Denmark | 548 | 444 | 252 | -43.2 |
| Sweden | 185 | 221 | 206 | -6.8 |
| Finland | 106 | 132 | 188 | 42.4 |
| Australia[c/] | ... | 67 | 98 | 46.3 |
| Switzerland | 110 | 29 | 38 | 31.0 |
| Ireland | 7 | 12 | 7 | -41.7 |
| Austria | 2 | 2 | 3 | 50.0 |
| Subtotal | 40,039 | 46,953 | 61,921 | 31.8 |
| Grand total | - | 95,144 | 126,907 | 33.4 |

a/ Soya beans, cottonseed, groundnuts, sunflower seed, rapeseed, sesame seed, copra and palm kernel. Does not include oil palm.

b/ The 1982 figure for these countries is not available and so this entry is for 1981 only.

c/ These countries include in their total soya bean crush, which is an element in total crush, figures for the October-September year for 1976/77 and 1977/78 as the calendar year figures are unavailable.

Source: Oil World, TDRI.

For the materials and countries shown in Table 5.4, the total crush in Africa declined from 1976-1977 to 1981-1982 by 17.4 per cent. However, the picture changes dramatically when oil palm is also considered. Thus, for oil palm which accounts for two thirds of all crushings in Africa, the production held steady. And in some countries, notably in West Africa, palm oil production expanded significantly at the expense of oilseed crushings. The importance of these shifts becomes evident when one considers their decreasing effect on imports of seeds and oils.

Data for Latin America are only available for four countries but they all exhibit very healthy rates of growth.

Brazil, for which figures are also available for the year 1970-1971, shows an astonishing 362 per cent growth over the 11 year period and a 66.3 per cent growth rate over the 1976/77-1981/82 period. Following this enormous expansion, Brazil became the second largest crusher in the world in 1981. Colombia doubled and Ecuador nearly tripled their crushings of oil palm between 1974-1976 and 1982. Honduras during the same period increased its oil palm crushing by some 50 per cent.

In the rest of the world, from 1967/77 to 1982/82, several countries exhibited considerable growth in oilseeds crushed, some of them albeit from a relatively small base; e.g. the People's Republic of China (97.1 per cent), Hungary (62.5 per cent), Spain (63.3 per cent), Belgium-Luxemburg (81 per cent), Greece (62.3 per cent), the Netherlands (65.9 per cent) and Canada (68.2 per cent). On the other hand the USSR, the fifth largest crusher in the world, is amongst five developed countries and centrally planned economies exhibiting a decline in crushings.

## 5.3 Capacity and its utilization in the oilseed processing

### 5.3.1 Definition of capacity utilization and of scale

Modern oil extraction plants are available world-wide. They must, however, be fitted into a tremendous variety of cultural environments and must therefore be operated in many different ways. The majority of the world's

oilseed crops are seasonal and to meet the problems this engenders, plants can be employed in several different ways: storage can be provided so that seed is available for crushing all year round; different oilseeds can be processed at different times of the year; or the plant can be operated for just a few months of the year. As examples, many of the world's soya bean solvent plants run on soya all year by buying seed throughout the year. In Mexico soya and safflower seed are harvested at different times of the year and plants are constructed to process soya for up to 7 months and safflower for the remainder of the year. In the Kathmandu valley of Nepal, rapeseed mills work for a few months of the year only.

Coconuts and oil palm bunches are harvested throughout the year and are always available fresh for processing locally. With oil palm there are several peaks and troughs and a mill is designed to cope with the peak crop level available.

Modern oil extraction plants are designed for continuous use. This operation is, however, difficult in some parts of the world. In the Pacific, it is usually possible to get a factory running 24 hours/day for 5 1/2-6 days of the week but no plant operates on Sunday. In Central America and parts of South America it is difficult to run plants overnight but it is possible to have long shifts running 12 hours/day.

Generalizations have to be made and this report assumes a 300 day year, having three 8-hour shifts per day which gives a plant running time of 7,200 hours per year. Clearly, the same plant operating for only 8 hours per day would only run for 2,400 hours, or one third of its capacity.

When identifying actual capacity levels, two further problems arise. The first is that most oilseed crushing equipment can handle a range of oilseed (with or without minor equipment modifications). However, the throughput rating differs with each oilseed and no uniform measurement is applicable. Secondly, stated crushing capacity in a number of countries includes a significant level of mothballed equipment. Whether or not such equipment could be made operational is a moot point in many cases.

Defining scale is extremely difficult when the process range lies between a few kilos and over one million tons per year. Certain arbitrary decisions have to be made particularly in defining the cut-off point between one scale and another.

The following values have been selected and relate more to equipment capacity than hours of operation.

| Type | Hours per year | Capacity per hour | Capacity per year |
|---|---|---|---|
| Village | 100-1,000 | 1 kg-15 kg | 100kg-15 tons |
| Small industry | 2,000 | 25 kg-10 tons | 50-20,000 tons |
| Medium industry | 2,000-7,200 | 10-25 tons | 20,000-180,000 tons |
| Large industry | 7,200 | 25-170 tons | 180,000-over 1,000,000 tons |

5.3.2 Crushing

The quantity and quality of the data vary considerably on the capacity and capacity utilization in global crushing and refining vary considerably. The following text tables are based on all available evidence; the detailed data can be obtained from the UNIDO secretariat. It should be noted that several countries are excluded from the tables due to a complete lack of data. The data in the tables must be treated as rough, but reasonably accurate estimates.

Due to the lack of data on available capacity it is not possible to estimate a capacity utilization figure for the centrally planned economies. It should be noted, however, that in Hungary, capacity is recorded as being inadequate to meet domestic demand and is consequently to be expanded. In Bulgaria, Romania and Yugoslavia, capacity is also scheduled to expand.

The total average global crush recorded in 1981-1982 is 144.9 million tons. (See tables 5.5 to 5.9.) Unfortunately due to the lack of capacity information, particularly for the developed countries and centrally planned economies, it is not possible to estimate a global capacity figure and therefore a capacity utilization figure.

Table 5.5. Summary of oilseed processing: Asia, 1981-1982 average (thousand tons)

| | Crush capacity | Actual crush | Capacity Utilization (%) |
|---|---|---|---|
| Malaysia | 33,226 | 12,256 | 37 |
| India | 17,250 | 8,029 | 49 |
| Indonesia | 7,012 | 3,951 | 56 |
| Philippines | 3,173 | 2,133 | 67 |
| Pakistan | 1,937 | 1,341 | 69 |
| Turkey | 1,970 | 1,205 | 61 |
| Taiwan Province of China | 1,300 | 1,070 | 82 |
| Republic of Korea | 900 | 411 | 46 |
| Bangladesh | 418 | 177 | 42 |
| Thailand | 431 | 157 | 36 |
| Sri Lanka | 326 | 120 | 37 |
| Papua New Guinea | 60 | 51 | 85 |
| Fiji | 63 | 26 | 42 |
| Iraq | 162 | ... | |
| Afghanistan | 112 | ... | |
| Subtotal | 68,068 | 30,927 | 45.4 |
| Total | 68,342 | 30,927 | 45.25 |

Note: Subtotal refers to those countries only for which both capacity and actual crush figures are available.

Source: Oil World, TDRI.

Table 5.6. Summary of oilseed processing: Africa, 1981-1982 average (thousand tons)

| | Crush capacity | Actual crush | Capacity Utilization (%) |
|---|---|---|---|
| Egypt | ... | 877 | |
| Ivory Coast | 3,000 | 798 | 27 |
| Sudan | 1,203 | 748 | 62 |
| Senegal | 950 | 363 | 38 |
| Cameroon | ... | 306 | |
| Nigeria | 1,000 | 181 | 18 |
| Benin | ... | 163 | |
| Niger | ... | 126 | |
| Morocco | 120 | 84 | 70 |
| Tanzania | 383 | 70 | 21 |
| Zaire | 400 | 60 | 15 |
| Algeria | ... | 44 | |
| Somalia | 102 | 11 | 11 |
| Ghana | 279 | ... | |
| Kenya | 150 | ... | |
| Chad | 60 | ... | |
| Subtotal | 7,213 | 2,315 | 32.1 |
| Total | 7,702 | 3,831 | |

Note: Subtotal refers to those countries only for which both capacity and actual crush figures are available.

Source: Oil World, TDRI.

Table 5.7. Summary of oilseed processing: Latin America, 1981-1982 average (thousand tons)

| | Crush capacity | Actual crush | Capacity Utilization (%) |
|---|---|---|---|
| Brazil | 27,000 | 14,335 | 53 |
| Argentina | 6,832 | 3,118 | 41 |
| Mexico | 5,000 | 2,373 | 47 |
| Colombia | 542 | 304 | 56 |
| Ecuador | ... | 164 | |
| Peru | 300 | 140 | 47 |
| Uruguay | 252 | 89 | 35 |
| Bolivia | 408 | 84 | 21 |
| Venezuela | 202 | 62 | 31 |
| Chile | ... | 26 | |
| Subtotal | 40,536 | 20,505 | 50.6 |
| Total | 40,536 | 20,695 | |

Note: Subtotal refers to those countries only for which both capacity and actual crush figures are available.

Source: Oil World, TDRI.

Table 5.8. Summary of oilseed processing: centrally planned economy countries 1981-1982 average (thousand tons)

| | Crush capacity | Actual crush | Capacity Utilization (%) |
|---|---|---|---|
| People's Republic of China | ... | 13,992 | |
| USSR | 11,392 | 9,443 | 83 |
| Rumania | ... | 1,284 | |
| Yugoslavia | ... | 591 | |
| Poland | 900 | 561 | 62 |
| Hungary | ... | 567 | |
| Bulgaria | ... | 463 | |
| Czechoslovakia | ... | 379 | |
| German Democratic Republic | ... | 330 | |
| Subtotal | 12,292 | 10,004 | 81.4 |
| Total | 12,292 | 27,610 | |

Note: Subtotal refers to those countries only for which both capacity and actual crush figures are available.

Source: Oil World, TDRI.

Due to the lack of data on available capacity, it is not possible to estimate a capacity utilization figure for the centrally planned economies. It should be noted, however, that in Hungary, capacity is recorded as being inadequate to meet domestic demand and is consequently to be expanded. In Bulgaria, Romania and Yugoslavia, capacity is also scheduled to expand.

Table 5.9. Summary of oilseed processing: developed market economy countries, 1981-1982 average (thousand tons)

| | Crush capacity | Actual crush | Capacity Utilization (%) |
|---|---|---|---|
| United States | 39,000 | 33,820 | 87 |
| Germany | 6,400 | 5,129 | 80 |
| Japan | 8,000 | 5,096 | 64 |
| Spain | 4,000 | 3,779 | 94 |
| Netherlands | 2,800 | 2,953 | * |
| Canada | 1,300 | 1,998 | ** |
| United Kingdom | ... | 1,669 | |
| France | ... | 1,662 | |
| Italy | ... | 1,586 | |
| Belgium/Luxembourg | ... | 1,582 | |
| Portugal | 1,000 | 587 | 55 |
| Greece | 510 | 474 | 93 |
| Norway | 320 | 348 | * |
| Denmark | ... | 252 | |
| Sweden | 215 | 206 | 96 |
| Finland | ... | 188 | |
| Australia | ... | 98 | |
| South Africa | ... | 486 | |
| Subtotal | 63,545 | 54,350 | 85.5 |
| Total | 63,545 | 61,873 | |

Note: Subtotal refers to those countries only for which both capacity and actual crush figures are available.

* The crush capacity figures is for soya beans only
** Some recent addition to capacity may have been omitted from the data used

Source: Oil World, TDRI.

It is however clear from the sources and from the evidence collected that capacity utilization in the developing countries is a great deal less than in the rest of the world. For the three developing regions shown, capacity utilization rates are estimated as follows:

| | |
|---|---|
| Asia: | 45.4 per cent |
| Africa: | 32.1 per cent |
| Latin America: | 50.6 per cent. |

The lowest recorded capacity utilization rate for the developed countries is, by contrast, 55 per cent for Portugal. For the USSR and Poland the figure is 83 per cent and 62 per cent, respectively. It is unfortunate that capacity utilization figures are not more widely available for the non-developing world but it is generally believed by the trade that average capacity utilization is between 65-85 per cent for these countries.

The countries with the biggest crushes in 1981-1982, including oil palm, are as follows:

| Country | Percentage of global crush |
|---|---|
| United States | 23.4 |
| Brazil | 9.8 |
| People's Republic of China | 9.7 |
| Malaysia | 8.5 |
| USSR | 6.1 |
| India | 5.6 |
| Federal Republic of Germany | 3.6 |
| Japan | 3.6 |
| Indonesia | 2.8 |
| Argentina | 2.1 |
| The Philippines | 1.5 |

### 5.3.3 Refining

The available information on refining is considerably thinner than the data for crushing and has been assembled from a selection of sources, including the Tropical Development and Research Institute (TDRI) in-house information and unpublished reports. The availability of the data varies from the Asian countries where there are returns of some kind for more than half the countries and the African countries where there is also a reasonable amount of information; by contrast, for the centrally planned economies there is no information at all and in the developed countries the only returns are for the United Kingdom and Australia. For no region are the data sufficient to assemble a regional or group total or to make comparisons across groups or regions.

From the information assembled on Asia, Malaysia, the largest crushing country, is easily also the largest refining country. There is reportedly a refining capacity of 4.7 million tons in Malaysia and, in 1981/82, 3.4 million tons of oil were actually refined. Given that the Malaysian crush is some 53 per cent greater than the crush in India it is likely that refining in Malaysia is on a greater scale than in India.

The only other significant figures for refining capacity are for the Philippines and for Indonesia. These countries possess a refining capacity of 644,000 tons and 548,000 tons respectively. The Philippines figure is for coconut oil only and would be somewhat larger, were other oils to be included. There are intentions to expand refining capacity in Pakistan and Malaysia.

Capacity utilization rates, range from 92 per cent for Bangladesh through 72 per cent for Malaysia, down to 22 per cent for Pakistan.

The African data are even less complete than those for the Asian countries. Refining capacities are only available for 5 countries and an actual refining figure exists for an even smaller number. The biggest refining countries recorded are Morocco and Egypt with 150,000 tons and 115,000 tons, respectively. Their capacity utilization rates are 75 per cent and 58 per cent.

Evidence of new refining capacity, either under construction or under consideration, was found only for Egypt.

Of the three developing regions, Latin America has yielded the least information on refining. There is information confirming the existence of refining capacity in five countries but for only two of them, Peru and Bolivia, is there an actual figure (and that for Peru includes refining of fish oil). The quantity of this information is inadequate to make any regional comparisons or generalizations.

Information on refining in the centrally planned economies is not available, and in the developed countries the situation is not much better. A figure for actual refining in Australia and a production table for refining in the United Kingdom are available. Clearly, the information is so sparse that no general comment can be made.

## 6. FACTORS AFFECTING PROCESSING CAPACITY AND CAPACITY UTILIZATION

The level of capacity and its utilization are affected by a wide range of technical and economic factors. This chapter discusses these with special reference to the developing countries.

The shortage of data and the limited resources available to the study preclude a full country-by-country analysis. However, an attempt has been made to identify some of the major economic issues for the more important oilseed-processing developing countries. The range of microeconomic circumstances affecting individual plant operation are so diverse that it is not possible to extend the discussion to this level, but it is felt that consideration of industrial conditions provide a useful explanation for many features of the crushing industry in developing countries. The lack of data relating to processing stages beyond crushing has already been referred to; clearly, analysis of these stages is not possible.

The discussion of technical factors is much more closely tied to specific areas of plant operation, i.e. micro-level consideration of the crushing process. Whilst it is very difficult to generalize from individual plant experience, an attempt is made to indicate the constraints on production levels and utilization rates which arise from the specifically technical aspects of crushing in many developing countries.

The operating efficiency of crushing plants depends not only on the level of capacity utilization but also on the efficiency of operations at any given level of utilization. The latter represents a key area of importance both in terms of the efficient use of scarce resources and the relative international competitiveness of oilseed crushing industries established in developing countries. The measure of such efficiency of utilization is the extent to which the minimum rated capacity of oil extraction is achieved. The latter is of key importance since oil is always the higher priced of the joint derivatives of crushing. Price differentials between oils and oilcakes in conjunction with oil to oilcake production ratios also mean that vegetable oil has the higher value per unit of seed crushed for all oilseeds, except soya beans.

## 6.1 Economic factors affecting processing capacity and its utilization

The wide range of economic factors affecting crushing capacity utilization stem from the complexities of the oilseed economy itself. Whilst many issues are common to all crushing countries, some are of more specific relevance to developing countries.

### 6.1.1 Supply side factors

The supply of oilseeds for crushing consists of the quantity and composition of domestic and imported seeds, reduced by exports and any amount used for other but crushing purposes. It is primarily affected by three factors: the level and composition of domestic oilseed production; demand for oilseeds other than for crushing; and the possibility of securing oilseeds from international trade.

#### Domestic oilseed production

Domestic oilseed production can be analyzed usefully in terms of both its level and its composition although the two cannot be entirely separated. The production function of oilseeds, sometimes referred to as the technological conditions of production, is dependent on a number of factors: most obviously the price of the oilseed in question and the prices of other oilseeds and other agricultural products, i.e. the relative profitability of production of differing oilseeds and other crops; the structure of the agricultural sector, i.e. its organization and efficiency; Government objectives and policies towards the oilseeds sector and the agricultural economy in general; the extent to which the specified production is in terms of the crop, or oilseed, itself or as a by-product, e.g. cottonseed, and demand.

Determining the availability of a particular oilseed for crushing is complicated by its seasonal production although the provision of storage can reduce problems in this area.

The problems of seed supply can be very different, depending on the level of operation to be serviced. For the purpose of classification it is helpful to sub-divide seed supply into the requirements for production at village, small, medium and large-scale levels.

At the village industry level, unselected seed indigenous to the area is grown as a subsistence crop, the producer using seed as a source for his own edible oil by extraction with simple techniques. At this subsistence level, supply and demand relate to the family group and the major external influences which might drastically reduce seed supply are agricultural and climatic (crop failures). Production and utilization of seed are both local.

In small but modern village processing, the seed is more efficiently milled using expellers. This is also the simplest level at which cash crop seed appears. As a cash crop, the smallholder is primarily interested in the return to labour so he reacts to seed price incentives. The mill receives ungraded seed in small lots.

If the seed is an annual crop, the mill either purchases seed for the year over several months or, provided seed sellers are willing, as required during the year. The number of mills competing for seed may influence this practise. Production and utilization of seed are usually local.

In a small industry, as distinguished from village processing the scale of operation progresses upwards towards the 20,000 ton/year level. The problems resemble those of the larger industries but the production and utilization of seed are usually local.

Many developing countries have medium- to large-scale oil mills capable of processing over 100 tons of oilseed per day. The supply of locally grown seed at this level or over can be fraught with problems. It is desirable that the mill be located centrally in an area growing seed intensely, utilizing as few suppliers as possible.

Many variations exist. Mills buy ungraded seed from local farmers and smallholders. Alternatively, if seed is supplied from a large, diffused area, it may be collected at a local Agricultural Marketing Board out-station and

then transported and pooled at a larger or main depot for onward transmission to the oil mill. Such an operation needs a well-developed and defined infrastructure and distribution network to succeed.

Oilseed production in most Asian developing countries is insufficient to meet domestic vegetable oil demand and the scale of crushing therefore partly depends upon the capacity to import oilseeds and the choice between oilseed imports and vegetable oil imports.

In many cases limited success in the agricultural sector in achieving increased oilseed production and variable yields year on year also limit crushing capacity utilization.

In contrast, a small number of countries have considerable surplus oilseed production over domestic needs, but even in these countries, capacity utilization is relatively low. Part of the explanation for this is that the surplus oilseed production of these countries is largely confined to the perennial tree crops with oil palm often predominating (the other major crop being coconuts). Oil palm has to be processed within hours of harvesting to avoid rapid deterioration of oil quality (i.e. rising the free fatty acid content). Oil extraction capacity has therefore to be geared to meet seasonal peak levels of production and since such equipment is unsuited to processing other oilseeds, capacity utilization levels fall below those technically possible. This situation also illustrates the fact that capacity and capacity utilization cannot be treated as a purely technological phenomenon. That is, a technical capacity may be an economically meaningless concept unless it recognizes, for example, seasonalities in factor inputs. In this sense, then, the economically feasible capacity utilization in the Asian countries may be much higher than that indicated by solely technological factors. This problem is exacerbated where oil palm production is expanding rapidly with the need to build oil expansion capacity in advance of production. Countries particularly affected by these issues include Malaysia, Indonesia and Papua New Guinea.

Because of the importance of cottonseed in their total oilseed crush, uncertainty as to crushing capacity requirements and utilization levels is a feature of several major Asian countries, including Pakistan and India. As a by-product, output of cottonseed is largely determined by market forces

exogenous to the oilseed economy. Palm kernels may also be regarded as a by-product of oil palm production and cultivation practices, although they are linked to the oil seed economy via the latter.

African countries have had achieved varying degrees of success in meeting their vegetable oil demand from domestic oilseed production. On balance, more countries are in deficit than surplus (table 6.1) although many countries exhibit either small net deficits or surpluses. In absolute terms, the influence of domestic production on oilseed crushing capacities is therefore less marked than in the case of many Asian countries. However, even small surpluses and deficits may have significance given the restricted scale of the oilseed economy in many African countries.

Oil palm cultivation in Africa has a similar influence on capacity levels and utilization as it does in the Asian countries although such cultivation is confined primarily to West Africa and to some equatorial states. The oil palm sector in most countries is considerably less dynamic than in the Asian producing countries and surplus crushing capacity arises in a number of cases as a result of falling oil palm production.

Cottonseed is important for two large scale crushing countries in particular - the Sudan and Egypt - and this introduces a degree of uncertainty into crushing requirements, cottonseed being essentially a by-product of cotton production. Palm kernels are significant in West and Equatorial Africa but the link with the palm oil sector is complicated because of kernel collection from wild palms. Such collection may vary considerably in response to international market pricing and tends to work against the establishment and/or full utilization of kernel crushing capacity.

Although oil palm and coconut cultivation are of some significance in the central and northern part of South America, production of oilseeds overall is dominated by annual crops. Of the annual oilseeds, soya beans usually predominate, with cottonseed and sunflower of secondary importance.

Most countries in the region are deficit countries in terms of meeting domestic vegetable oil requirements. However, a small number of countries in the south of the continent, most notably Brazil and Argentina, produce very large surpluses. The influence of cottonseed as a by-product is significant in a number of countries, particularly Mexico and Argentina.

Uses of oilseed other than for crushing

The availability of seed for crushing also depends on competing requirements: these include the direct use of oilseeds for food, the direct use of oilseed for animal feed, and the use of oilseed as seed for further production. The availability is also reduced by simple wastage. Food use is generally the most important competing area although its significance varies considerably by country and by oilseed. Obviously the demand for oilseeds for direct consumption hinges upon several factors - the population level, population growth, income levels, the distribution of income, the price of the oilseed, tastes, etc.

Human consumption of oilseeds or non-crushing derivatives is more important in many Asian countries than in developing countries elsewhere. Such utilization acts as a significant, if variable constraint on the availability of oilseed for crushing, particularly in the case of groundnuts, coconuts, soya beans and sesame seed.

Groundnut utilization, other than for crushing is widespread throughout most Asian countries with particularly large volumes consumed in Indonesia. Alternative utilization also takes the form of exports of high grade nuts for direct consumption elsewhere, e.g. in the case of hand picked selected grade exports from India.

Coconut cultivation and associated non-crushed utilization is more geographically restricted and per capita consumption levels vary considerably. In almost all cases, however, non-crushing uses take precedence over copra production for crushing as a result of differentials in relative pricing and returns to producers. Competition for coconut supplies also arises from more modern commercial products, most notably dessicated coconut, largely produced for export. Countries most affected by such competing demands include Sri Lanka, Indonesia, Thailand and (Southern) India. In the

Philippines, however, scale of production and the relatively restricted demand for coconut as a traditional food source mean that such constraints are of little importance.

Soya bean utilization for non-crushing purposes is largely confined to East Asia (and Chinese overseas communities elsewhere). Substantial volumes are consumed in the form of traditionally processed food products, the Republic of Korea and Taiwan Province of China being among the countries most affected.

In general the most important form of non-crushing utilization is the traditionally preferred and processed food products such as tofu. Such needs generally receive priority and hence availabilities for crushing are constrained and liable to more substantial degrees of fluctuation in the context of variable oilseed production levels. Consequently, both the level of crushing capacity and the degree of capacity utilization may be adversely affected.

Human consumption of oilseeds is of some significance in a number of African countries. Groundnut edible utilization is widespread and is particularly large (in absolute terms) in Nigeria. To varying degrees groundnuts are also exported for direct consumption elsewhere but the level of such trade is usually quite small. Direct consumption of sesame seed is also significant in North-East Africa.

As in the Asian countries, the combined effect of direct oilseed consumption requirements and variable production levels is to restrict availabilities for crushing and to introduce considerable instability in supplies.

Compared to other regions, direct consumption of oilseeds or non-crushing derivatives is relatively unimportant in many Latin American countries. Groundnut and copra availability are the most affected by such forms of utilization although coconut production is restricted geographically and generally plays a minor role in the oilseed economies of the region.

The relatively small role of such direct consumption requirements reduces the instability introduced into oilseed availability for crushing that is apparent for many developing countries outside the region.

International trade

International trade in oilseeds and the derivatives of crushing - oil and oilcake - influences both the supply and the demand. For countries with a shortage of oil, importing oilseeds for crushing is an option as is importing oil or oilcake or even substitutes for these. The participation of a given country in international trade is of course dependent on the factors operating in the market.

The trade options available generally highlight a range of issues confronting the importing countries.

- the relative pricing of one oilseed as against another and the opportunity cost of domestic production as against buying from abroad;

- the availability of foreign exchange; and

- government policies towards production, trade, pricing etc.

Conversely, for countries with surplus oilseed production the possibility of exporting seeds or derivatives arises. This can be to crushers overseas or for non-crushing utilization.

Asia

Trade and trade related issues are of variable importance amongst Asian developing countries and may be evaluated in the context of a broad distinction drawn between countries whose oilseed production exceeds or falls short of domestic vegetable oil demand (table 6.1).[73/]

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73/ Deficit country; imports greater than exports in the year 1982. Surplus country; exports greater than imports in the year 1982.

The majority of mainland Asian countries are in the deficit grouping, i.e. net importers in vegetable oil equivalents. The major countries of the Indian sub-continent, India, Pakistan and Bangladesh are notable importers as a result of strong domestic demand pressures and constrained domestic oilseed availability (i.e. both production constraints and demand for oilseeds for purposes other than crushing). In contrast, South-East Asian countries include some large-scale net exporters; Malaysia, Philippines, Indonesia and Papua New Guinea. The exports of these countries are very largely made up from oil palm and coconut production.

Many net importing countries meet their requirements via oil rather than oilseed imports. Oil imports are favoured in part as a result of the international availability of oils and competitive pricing but they also arise from the nature and significance of trade within the Asian region. A significant proportion of the needs of deficit countries are met by oil palm which can only be traded in the form of oil. Regional availability and pricing make the latter oil highly attractive, particularly in the context of the foreign exchange difficulties faced by a number of deficit countries. The result is, however, a reduction in the crushing requirements in these countries.

Many countries in the Middle East region are also net importers, partly because potential domestic oilseed production is quite constrained. Oil rather than oilseed imports are again often of greatest importance with palm oil taking a significant role. In some cases the strength of livestock feed requirements acts as an offsetting factor as noted below.

Aside from palm oil exporters, the bulk of exports comprise palm kernels and coconut derivatives. Within Asia and especially South-East Asia, a conscious decision by Governments has resulted in policies designed to promote domestic crushing of such oilseeds prior to export, which necessitates an often very rapid expansion in crushing capacity.

Africa

Vegetable oil surpluses and deficits are relatively small in most African countries. Therefore, trade related issues are of relatively less importance to crushing in Africa than they are in Asia and Latin America.

Deficit countries are in a majority most notably in North Africa because of limitations to production other than olives and strength of demand stemming from relatively high income levels. In the majority of cases, deficit countries import oils rather than oilseeds and hence inhibit domestic crushing. However, North African countries do import fairly significant volumes of seed, partly because of developments in their livestock feed sectors (see below).

Only two relatively large oil exporting countries exist in Africa: the Sudan and the Ivory Coast. Most exporting countries export oil rather than oilseeds, the major exception being the Sudan where the export of sesame seed for direct consumption is significant.

Latin America

Except for Argentina, Brazil and Paraguay, virtually all countries are net importers. Venezuela and Mexico both imported more than 230,000 tons on the average in 1982 but most countries' imports are relatively modest. Most of these deficit countries import vegetable oil rather than oilseed, the exception being Mexico with very substantial soya bean and sunflower seed imports.

The pattern of importing oil may arise in part from the dominant position of soya beans and oil in regional production and trade since a number of smaller deficit countries do not have the capacity for crushing soya beans. Where the requirements of the domestic market are small, the scale of such plants may be too low to operate economically in the context of competitively priced oil available on the international market.

Amongst the few surplus countries, soya exports predominate with sunflower being of secondary importance. Brazilian exports are largely in the form of oil and cake whereas those of Argentina and Paraguay include significant volumes of seed.

Government support policies for crushing favour continued expansion in capacity in association with plans to expand oilseed production.

### 6.1.2 Demand side factors

Analysing the domestic demand for oilseeds is more complex than if the product were a single derivative. These complexities arise from the fact that oilseeds have differing oilcake/oil ratios and different qualities and purposes and hence variable market values.

To analyse the domestic demand for vegetable oils is relatively straightforward. In the developing countries, demand is especially likely to grow for several reasons: the historically low per capita consumption and hence potential for growth, the prevalent high rate of population expansion, the tendency of consumption of oil to increase with increasing incomes and the constrained alternatives to oil consumption, particularly the shortage of animal fats. In some countries, however, the purchase of oil for domestic uses is rationed.

The demand for vegetable oilcake is derived several stages removed from human consumption needs, that is the vast majority of oilcake demand is derived from livestock feed demand. This in turn hinges on the scale of the livestock industry, the quality of husbandry and management, the nature of the feed regimes and the availability of alternative feeds, especially protein feeds. The scale and composition of the livestock industry in a given country in turn hinges upon both domestic and international market factors (i.e incomes, elasticities, alternatives etc.). Livestock composition changes over time in response both to production capacities and consumer demand and, generally, involves increasing emphasis on monogastrics, e.g. pigs and poultry, where opportunities for intensive feeding are greater.

In general, vegetable oil demand is the most crucial factor on the demand side of the oilseed economy/processing industry of a developing country although for some surplus oilseed producing countries, the international oilcake market may be of greater importance.

The joint production of oil and oilcake from crushing complicates the effect of demand side market forces both because of the widely differing market circumstances facing the two derivatives and because of the variable value of differing oilseeds in terms of oil and oilcake content and quality.

As elsewhere, demand for vegetable oils is generally of much greater significance in Asian developing countries than is the demand for oilcake. Factors contributing to the strength of vegetable oil demand have already been briefly noted. The strength of such demand has often been reinforced by government price policies. The imbalance between domestic oil demand and oilcake demand tends to favour oil over oilseed imports by oil deficit countries. However, vegetable oil deficit countries with relatively high per capita incomes, e.g. in East Asia and especially in the Middle East, have high effective demand levels for meat and dairy products resulting in an expansion of livestock feed utilization, including oilcakes. In such cases, oilseed imports (rather than oil imports alone) may be more attractive and hence contribute to domestic crushing industries. Examples of the latter case include Saudi Arabia and the Republic of Korea.

Oilseed imports may arise even in countries with a substantial net surplus of vegetable oil production. Such imports stem from the requirements of the domestic feed industry and are evident in both Malaysia and the Philippines. In Malaysia, domestic production is inadequate to meet feed requirements because of the overwhelming dominance of oil palm whilst Philippine imports stem from the rather limited feed value of copra cake.

Factors affecting domestic vegetable oil demand in Africa largely correspond to those affecting developing countries elsewhere. However, for some, mainly North African countries, the development of livestock production with its associated feed requirements, produces a greater degree of balance in demand between crushing derivatives.

Demand for vegetable oil appears to be stronger than that for oilcake in most of the countries under review in Latin America. This demand is strengthened by relatively high population growth rates and per capita incomes. Whilst meat production and hence livestock feed demand has also expanded for similar reasons, oilcake demand is not a particularly strong feature in many countries. This is because of the predominance of ruminants in many livestock populations and the ready availability of pasture.

International feed demand is, however, highly significant for the few large scale surplus/exporting countries with their high proportion of soya in oilseed production and crushing. Levels of capacity utilization in these countries are therefore linked, to a degree, to developments in the international soya economy.

### 6.1.3 Capacity utilization and consumption patterns in developing countries

Table 6.1 contains a classification of 52 oil deficit and surplus countries into five levels of apparent per capita consumption of oils and fats:[74/]

| Level | 1982 Consumption kg/cap./year |
|---|---|
| (a) | 5 or less |
| (b) | 6 to 10 |
| (c) | 11 to 15 |
| (d) | 16 to 20 |
| (e) | greater than 20 |

An analysis of crushing capacity utilization within the 10 groups of countries shows:

(1) Deficit and surplus countries present a wide apparent consumption distribution, i.e. large surplus countries like Malaysia, Brazil and the Philippines fall into three different consumption levels e, d and b; India, the country with the largest deficit, falls into consumption level b, while other large deficit countries like Mexico and Egypt belong to groups e and c.

(2) No clear differentiation was found in an analysis of surplus and deficit countries and the levels of capacity utilization at the crushing stages. Low levels of capacity utilization (as low as 15-18 per cent) are found in deficit and surplus countries, i.e. Zaire - a surplus country and Nigeria - a deficit country.

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74/ Total fats (animal plus vegetable).

Table 6.1. Crushing capacity utilization in vegetable oil surplus and deficit countries with different fat consumption levels (1982)

| Vegetable oil surplus countries | Surplus (thousand tons) | Crushing capacity utilization (%) |
|---|---|---|
| Fat consumption level (e) (20 kg/cap.) | | |
| Malaysia | 2,580 | 37 |
| Paraguay | 267 | ... |
| Fiji | 6 | 42 |
| Senegal | 4 | 38 |
| Fat consumption level (d) (16-20 kg/cap.) | | |
| Brazil | 1,299 | 53 |
| Argentina | 911 | 41 |
| Ivory Coast*/ | 101 | 27 |
| Cameroon*/ | 12 | ... |
| Fat consumption level (c) (11-15 kg/cap.) | | |
| Sudan | 81 | 62 |
| Zimbabwe | 1 | ... |
| Fat consumption level (b) (6-10 kg/cap.) | | |
| Philippines | 1,037 | 67 |
| Indonesia*/ | 383 | 56 |
| Zaire*/ | 27 | 15 |
| Mali | 11 | ... |
| Guatemala | 7 | ... |
| Fat consumption level (a) (5 or less kg/cap.) | | |
| Sri Lanka | 15 | 37 |
| Malawi | 10 | ... |
| Afghanistan | 4 | ... |
| Papua New Guinea*/ | 2.5 | 85 |

Table 6.1. (cont'd)

| Vegetable oil deficit countries | Deficit (thousand tons) | Crushing capacity utilization (%) |
|---|---|---|
| Fat consumption level (e) (20 kg/cap.) | | |
| Egypt | 302 | ... |
| Algeria | 243 | ... |
| Venezuela | 237 | 31 |
| Tunisia | 23 | ... |
| Syria | 17 | ... |
| Fat consumption level (d) (16-20 kg/cap.) | | |
| Nigeria*/ | 107 | 18 |
| Saudi Arabia | 85 | ... |
| Chile | 70 | ... |
| Angola | 39 | ... |
| Ecuador*/ | 29 | ... |
| Fat consumption level (c) (11-15 kg/cap.) | | |
| Pakistan | 415 | 69 |
| Mexico | 308 | 47 |
| Morocco | 167 | 70 |
| Turkey | 125 | 61 |
| Republic of Korea | 118 | ... |
| Colombia*/ | 97 | 56 |
| Iraq | 95 | ... |
| Peru*/ | 54 | 47 |
| Dominican Republic | 54 | ... |
| Bolivia | 14 | 21 |
| El Salvador | 6 | ... |
| Uruguay | 1 | ... |
| Fat consumption level (b) (6-10 kg/cap.) | | |
| India | 1,345 | 49 |
| Kenya | 83 | ... |
| Haiti | 22 | ... |
| Ghana | 7 | ... |
| Honduras | 4 | ... |
| Mozambique | 2 | ... |
| Tanzania | 1 | 21 |
| Fat consumption level (a) (5 or less kg/cap.) | | |
| Bangladesh | 116 | 42 |
| Thailand | 58 | 36 |
| Ethiopia | 7 | ... |
| Nepal | 2 | ... |

Note: Palm oil producing countries are shown with an asterisk.

Source: FAO, Oil World, UNIDO secretariat calculations.

- High levels of capacity utilization (67-85 per cent) are found in both deficit and surplus countries, Morocco, Pakistan, the Philippines and Papua New Guinea.

(3) The seasonal effect of oil palm crushing is not clearly reflected in the capacity utilization in the case of 7 out of the 12 world palm oil producing countries.

(4) No relationship is registered between the levels of apparent fat consumption and capacity utilization in oil surplus countries.

These findings, as was discussed earlier, can be explained by the complexity and wide range of economical factors that affect the level of capacity utilization.

### 6.1.4 Conclusions

The combined effects of domestic oilseed production and non-crushing utilization are easily the most important influences on the level of crushing capacity and utilization in Asian developing countries. Vegetable oil deficit countries crush virtually all of the available oilseeds as indeed do the surplus countries. In the latter case this is partly due to necessity as oil palm has been grown as a result of government policies.

Trade issues may be of secondary importance. In deficit countries the tendency to import oil rather than oilseeds tends to inhibit domestic crushing although a minority of wealthier countries import part of their needs in the form of oilseeds to satisfy their livestock feed demand. The latter feature also arises in some oil surplus countries.

Unique features of the oil palm, i.e. the necessity to extract oil at the point of production and the absence of oilcake as a joint product, have a broad ranging impact on Asian developing countries. Whilst the capacity of oil extraction industries in palm growing countries is automatically linked to the level of oil palm production, other countries' crushing industries are adversely affected to the extent that imports of palm oil arise. The absence

of joint production of oilcake also helps to explain certain apparent anomalies, most notably the import of oilseeds by Malaysia which has a high surplus of domestic vegetable oil production over consumption needs.

The factors discussed above help to explain both the level and rate of utilization of crushing capacity in Asian countries, although it is not possible to provide any degree of precision in the analyses. In the majority of cases the factors identified tend to contribute to relatively low levels of capacity utilization (e.g. in comparison to developed countries). A further issue not covered earlier is traditional as opposed to modern oilseed crushing. In many Asian countries, particularly those on the Indian sub-continent and Indonesia, traditional extraction accounts for a substantial proportion of total oilseed crushing. Whilst the relative importance of traditional processing may be declining to varying degrees, it is likely to influence both the distribution and scale of future commercial production.

Crushing levels in African countries are closely linked to domestic production levels with relatively restricted participation in international oilseed trade. Variable production of oilseeds in conjunction with the non-crushing requirements for oilseeds for human consumption introduce quite substantial fluctuations in availabilities for the crushing industry. In a number of countries, traditional extraction of oil is important, especially in West African countries. However, some of such production utilizes more or less wild crops, (e.g. of oil palm) and does not directly impinge upon commercial availabilities.

In general, crushing levels in Latin American countries are quite closely linked to domestic oilseed production. However, partial exceptions exist for two major countries, Mexico and Argentina. In the case of Mexico, a vegetable oil deficit country, substantial volumes of seed, notably soya, are imported. In Argentina crushing levels have tended to lag behind expansion in oilseed production.

The scale of individual crushing plants appears to be correlated, to a degree, with the overall scale of production in the country concerned, i.e. with large scale plants in major producing/crushing countries. The type of plant is also influenced by the composition of oilseed production, with

extensive solvent extraction capacity geared to soya processing. With crushing largely confined to the commercial sector, traditional oil extraction is of little significance for most countries in Latin America.

## 6.2 Technical factors affecting processing capacity and operating efficiency

Evaluation of technical factors entails an examination of each stage in the processing operations at plant level. Given the range of equipment available, almost any desired capacity level can be met both at national and at plant level. However, the choice of technology adopted may be influenced by both the level of oilseed production and its composition.

Technical factors are of greatest significance in relation to operating efficiency, defined to include both the level of capacity utilization achieved and the efficiency of oil extraction or refining for a given throughput of oilseeds. Capacity utilization may be affected by a wide range of factors, but certain of these, e.g. storage and spare parts, are found on the basis of field experience in developing countries to be of particular importance. Efficiency of oil extraction and the quality of derived oil are similarly affected by a range of factors of which spare parts and management are found to be of special significance.

A selection of important technical factors are discussed below and, where possible, an attempt is made to provide indicators of their relative importance, notably in relation to operating efficiency.

### 6.2.1 Oilseed reception, storage and pre-treatment

The layout of the mill must be such that there are no problems with reception and storage of seed. The reception area must be sufficiently large to cater for regular deliveries of seed without forming a bottleneck. For oil palm and coconut which are perennial crops, raw material comes in throughout the year; with oil palm this is daily. For the annuals which include soya, safflower, sunflower, sesame, cottonseed, rape, mustard and groundnuts there might be intense seasonal activity requiring storage capacity to be planned for a year.

Safe seed storage should be capable of minimizing seed quality deterioration and depends on many factors. The plant might have to include a provision for drying seed before it can be stored safely. Seed must also be protected from a variety of pests and kept covered to prevent damage by rain. Seed can be received and stored in bags or bulked in storage silos. Generally it is better to have seed stored in a number of small silos rather than in a few big ones.

If the seed is stored incorrectly there can be significant losses due to attack by rodents or damage by fungi and this may result in the consignement being condemned. If less severe, it may make the seed difficult to process or may result in a high acid and/or oxidized oil which is difficult or impossible to refine and market.

Overall storage capacity may influence the level of crushing capacity especially for annual oilseeds with short seasonal harvest periods and hence greater storage requirements. Poor oilseed storage facilities may also reduce capacity utilization both because of limitations in the amount of storage and, where inadequate facilities lead to deterioriation in seed quality, to the point where batches are rejected.

More frequently the constraints imposed by poor storage affect the quality of seed. Oilseed stored for long periods are especially susceptible. For example, seed stored over a 6 month period may result in a rise in free fatty acid levels from around 1 to 2 per cent to 6 to 7 per cent. Even higher free fatty acid levels may occur; beyond the 10 per cent level, oil refining is uneconomic even where physical refining (with lower loss levels than chemical refining) is undertaken.

Seed received at the mill can have a significant trash content and should be cleaned before processing. Failure to do so will lower throughput or damage plant machinery which, apart from causing plant shut down, may result in expensive and unnecessary repair bills.

Some oilseeds are decorticated before oil extraction. Advantages include increased throughput and residual meals with a higher protein content and sometimes crude oils which are more easily refined. If, however, decortication equipment is not kept in good running order, loss of kernel to the hull fraction can be significant resulting in lower oil yield per unit of original seed.

### 6.2.2 Oil extraction and refining plant

There are many types of plant available for edible oil extraction. Selection of plant depends on the quantity and types of seed to be processed. Expellers can process most oilseeds but even the most efficient will leave over 4 per cent oil in the cake. Expellers are the only real choice when seed availability is less than 10,000 tons per year. Above this level solvent extraction or pre-press solvent extraction is possible.

Pre-press solvent extraction is as versatile as expelling in terms of the range of oilseed that can be processed. High oil content seeds are first expelled to give cake containing 17 to 20 per cent oil which is subsequently solvent extracted. Clearly the throughput of expeller(s) and solvent extractor must be matched.

Direct solvent extraction plants are less versatile than the other types of plant noted above. They are particularly well adapted for use with soya beans and with oil cakes from other oilseeds having 17 to 20 per cent residual oil. Extractors which agitate or turn the seed bed halfway through the extraction cycle are claimed to be able to extract oil from seeds having up to 40 per cent oil content. One manufacturer of percolation/immersion technology claims to solvent extract seeds having up to 70 per cent oil content. Thus, if the plant is expected to process a variety of different oil content seeds, the extraction technology needs careful consideration.

Expellers have worms, flights, cage bars, knife bars and chokes etc. which exhibit continuous wear. Refining equipment consist of tanks, pressure vessels, pipelines, valves, pumps etc., all of which will deteriorate with use causing leakage and contamination. Regular replacement or refurbishing is

necessary to maintain efficient oil extraction and refining. Also correct seed conditioning is important; too much or too little moisture and heating of seed can reduce expeller efficiency. In solvent extraction, wear of flaking rolls is important because flake thickness is critical to good solvent extraction.

The choice available between crushing and refining technology is sufficiently wide to cover almost any level of desired capacity. However, the choice of technology is influenced by both the scale and type of oilseed available. Expellers are the only realistic choice at capacities below 10,000 tons per annum whilst direct solvent extraction is less versatile, i.e. it can only effectively handle oilseeds and oilcakes with relatively low oil contents. Relatively small scale plants where expellers are the only option are thus, at some disadvantage in terms of operating efficiency in comparison to cases where solvent extraction can be applied, since expelling generally leaves at least 4 per cent residual oil in oilcake in comparison to below 1 per cent residual oil for solvent plants (and pre-press expeller/ solvent plants).

### 6.2.3 Maintenance and spare parts

The proper organization of maintenance schedules and spares procurement is essential for any enterprise wishing to achieve an efficient, cost effective undertaking. It is therefore important to establish genuine and reliable sources of spare parts for equipment requiring a regular replacement on a preventative maintenance basis. The usual procedure adopted on deciding the scope of such maintenance procedures is to consult the equipment manufacturers who, on the basis of past operational experience, are able to advise on spares to be carried and the timetable for replacement against the operating cycles of a given material being processed.

The consequences of the non-availability of suitable spares and the lack of control of preventative maintenance procedures can be significant; starting with a fall in production levels and efficiency and leading to an eventual shut down of plan due to ultimate failure of key equipment. The latter situation could result in complete machines having to be replaced because of the nature of the failure induced.

As a general rule, spares are best obtained from the original equipment maker. However, there are situations where alternative local sources can provide these items at less cost. But the specification of materials used in their manufacture together with compatible surface finishes and tolerances must be correct. If these local spares fail to meet the original specifications on any of these aspects, the effect on equipment performance and durability could be significant. Thus, it is essential to confirm that the local spares conform in all respects to the original equipment specifications and drawings.

Where maintenance procedures involve re-furbishing of parts, as with some expeller worms (screws), it is important to confirm that the techniques employed and the materials used will result in a final result compatible with the materials and surface finishes as specified for the original machines.

The role of spares in overall plant operations should be given proper priority in the organization of any oil extraction enterprise. It is clearly false economy to adopt any other approach on these matters.

Maintenance and spare parts usually represent the most critical area with respect to the potential technical constraints in crushing performance. For example, capacity utilization may be critically affected by breakdown resulting from weaknesses in maintenance scheduling and performance and poor spare part availability and quality. For similar reasons oil extraction rates are often poor; residual oil levels between 10 per cent to 20 per cent are commonly found in expeller oilcake rather than the levels around 4 per cent that are technically feasible.

### 6.2.4 Conclusions

Given the range of technology available, pressing equipment can meet almost any desired level of capacity. Smaller-scale enterprises where expellers are the only real choice are at a disadvantage in terms of oil extraction efficiency leaving as much as 4 per cent residual oil in oilcake. In comparison larger scale enterprises can employ solvent extraction to produce oilcake containing less than 1 per cent residual oil.

Capacity utilization may be affected by a range of factors but the most important are usually problems with maintenance, lack of spares and limitations on storage capacity.

Operating efficiency, in the sense of oil extraction rates achieved compared to those technically possible, are affected by the choice of equipment noted above. However, easily the most important factor is the extent to which maintenance and spare parts are adequately covered. Where refining is undertaken (as is often the case), storage facilities are also particularly important since poor storage may result in high ffa levels and hence heavy losses in refining.

## 7. FURTHER ISSUES RELATING TO PROCESSING

### 7.1 Economics of small-scale processing

The economics of small scale expellers represent an area of particular importance given the widespread existence of traditional small scale units in many developed countries and the potential for improved efficiency afforded by the introduction of modern technology.

The development of traditional technology and modern village oil extraction equipment has been particularly marked on the Indian sub-continent (India, Bangladesh, Nepal, Pakistan and Sri Lanka) where today many hundreds of thousands of these ventures co-exist with their larger scale counterparts which invariably consist of expeller and/or solvent plants. It must therefore be concluded that these smaller ventures operate successfully in their own environment. As well as purchasing seed on their own account and selling oil and cake, many operators will also extract, for a fee, oil from seed provided by farmers, householders and other traders. The fee could be either a cash payment or alternatively oilcake and/or a portion of the extracted oil could be retained. Nowadays, the products of this scale of operations are exclusively for local domestic consumption.

Medium-scale edible oil production in developing countries demands a high level of skills (technical, managerial, administrative). In many cases these skills have not developed quickly enough with the result that the industry operates well under capacity and the domestic market, particularly in remote areas, remains unsatisfied. In such circumstances the introduction of small-scale processing, which is not so skill intensive may offer a viable alternative. Such a development may also stimulate increased production of oilseeds in an area which could ultimately benefit large processors as well. It must be noted, however, that the establishment of even small scale enterprises may present difficulties, for example, the problem of obtaining spare parts noted above.

Obviously, it is impossible to provide a detailed economic analysis which would cover all circumstances and situations but the components of such an analysis can be listed in order to provide a framework for application:

(a) Method of operation: either custom milling or seed purchase by the mill and the subsequent sale of cake and oil. The choice would depend on local requirements.

(b) Technology: at its simplest, consisting of an expeller and drums for collection and clarification of crude oil. The efficiency of oil extraction and, in particular, the recovery of clean oil for sale might be improved considerably by inclusion of seed cleaning and conditioning equipment and an oil filter press.

(c) Yield of products: oil and cake yields will depend on the oilcake used but even for a particular oilseed there will be variations depending on operation skill, quality of oilseed, level of maintenance and spare replacement.

(d) Markets for products: the market will probably be much more localized than for a larger factory. The products might be expected to have a simpler packaging and distribution network and therefore to be used more quickly. Crude oil production and marketing is probably more widely practiced than for refined oil in this sector. Crude oil will have a characteristic taste and smell, often termed traditional, which will depend on the oilseed and the method of oil extraction. Although analysis by modern chemical techniques would classify these oils as inferior to their refined oil counterparts, their prompt use and flavour capability frequently ensures preference on traditional markets.

Cake sales can be to the animal feed market, smallholders or large-scale framers. Alternatively, because there can be a significant residue oil content in the cake (as much as 20 per cent), it might be sold to larger scale extraction factories for the production of oil for soap manufacture.

(e) Labour and training: in contrast to their medium to large scale counterparts, small scale mills are labour intensive. The level of skill demanded, though not high in any particular area, must be considerable and the same people might be involved in each stage from seed reception to edible oil distribution, maintenance of machine and basic book-keeping.

(f) Maintenance and spares: no less important than for larger factories. With the operation being entirely domestic there is no generation of foreign exchange that could facilitate the import of spares from abroad. If spares have to be imported, the Government should have a rural credit scheme from which foreign exchange can be made available for spares replacement. Agents for overseas companies will only operate a spares replacement programme when there is sufficient local business to justify this. The alternative to importing spares is to employ skilled blacksmiths to refurbish components of machinery locally.

(g) Finance: setting up a small scale village oil expeller can require considerable sums of money when compared to a typical village income from subsistence agriculture or wage employment. The equipment for the factory might have to be imported and this will require foreign exchange. Buildings for the factory will have to be constructed, and perhaps even land purchased.

Commercial banks do not give credit without collateral and, for villagers or those wishing to set up small scale oil extraction factories, this can be a severe financial constraint to development. Some countries now operate schemes where the Central Bank will guarantee the loan advanced by the commercial bank, and to this end, co-operatives might have a better chance of securing loans than individuals.

Working capital is an essential requirement and the amount needed will depend on the method of plant operation and expected sales turnover. The major variable cost will be seed purchase (up to 80 per cent of the total annual cost even in the first year of operation). The method of seed purchase is therefore of considerable importance. For a perennial crop (e.g. oil palm and coconut) financing a month of operation may be adequate. For an annual crop (harvested over 2-3 month period) the cost of purchasing seed for the whole year would be considerable and could make an otherwise well structured operation difficult to establish. It would be preferable to buy seed on a regular monthly basis from local farmers or a local Agricultural Marketing Board particularly if the farmer requires income as a lump sum after seed harvest.

The viability of small scale expellers hinges upon individual financial and economic analyses which should take full account of government policies, especially price policies likely to affect raw materials and/or end products. It is probable, however, that a positive return would be indicated in a variety of circumstances and developing countries.

## 7.2 Transnational corporations in food processing

About one third of the food processed outside the centrally planned economies is produced by large enterprises - that is those with 1976 food-processing revenues in excess of $US 300 million. Some 189 firms were found to fit this definition, all but one of which (Bunge and Born) are based in the developed countries. Many of those companies are transnational. Table 7.1 shows 28 firms that have declared a major interest in vegetable oil processing. Just as with food processing TNCs in general, a high proportion of the firms are highly diversified, both within food processing and among non-food manufacturing and service activities. In fact, of the 28 firms listed all but Nisshin Oil Mills have several processing enterprises other than vegetable oils. Many of the biggest companies have lines quite unrelated to food, including steel mills, oil refining, mining, publishing, travel agencies, hotels etc.

The manner in which some of these firms have achieved their position in the food processing sector is also relevant. For a significant number of the largest food processing firms, prominence in this industry grew out of other food related activities, i.e. commodity trade, shipping and finance. Cargill, Mitsui, Continental Grain, Bunge and Born and the East Asiatic Company, among others, moved into food processing as an extension of their trading activities. Nearly all the largest food retailers of Europe, North America and Japan have also integrated upstream into processing. Several leading pharmaceutical and toiletries manufacturers have similarly expanded their product lines to include food, e.g. Proctor and Gamble, Foremost-McKesson and Colgate-Palmolive. Other firms have used their food processing base to diversify into other areas, for example, General Mills are now engaged in numerous lines of business outside the food industry.

Table 7.1. Revenues, assets and employment of leading oilseed processing firms ordered by rank of total food sales, 1976

| Rank | Parent company | Home country | Food processing revenue ($US mill) | Total revenue | | Total assets | | Total employment | | Net income | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Amount ($US mill) | Proportion foreign (%) | Amount ($US mill) | Proportion foreign (%) | Number | Proportion foreign (%) | Amount ($US mill) | Proportion foreign (%) |
| 1 | Unilever Ltd. | Neths/UK | 7,900 | 14,800 | 71 | 5,978 | 36 | 331,000 | 44 | 1,277 | 51 |
| 5 | Esmark Inc. | USA | 3,955 | 5,301 | 16 | 710 | 17 | 47,000 | ... | 83 | 14 |
| 9 | Ralston Purina Co. | USA | 2,366 | 3,394 | 24 | 766 | 14 | 59,000 | 20 | 126 | 14 |
| 11 | United Brands Co. | USA | 2,130 | 2,277 | 26 | 499 | 69 | 48,000 | ... | 16 | ... |
| 13 | Imperial Group Ltd. | UK | 2,071 | 5,790 | 12 | 1,486 | ... | 96,700 | 10 | 132 | ... |
| 14 | Archer-Daniels-Midland Co. | USA | 2,066 | 2,119 | 27 | 415 | ... | 4,873 | ... | 61.4 | ... |
| 16 | Associated British Foods | UK | 2,051 | 3,012 | ... | ... | ... | ... | ... | ... | ... |
| 22 | Rank Hovis McDougall | UK | 1,801 | 1,861 | 13 | 721 | ... | 58,300 | 9 | 95 | 20 |
| 23 | Proctor & Gamble | USA | 1,801 | 7,349 | 25 | 2,625 | 19 | 54,000 | 33 | 461 | 18 |
| 24 | Nabisco Inc. | USA | 1,780 | 2,027 | 29 | 447 | 37 | 48,000 | 45 | 77 | 11 |
| 25 | General Mills | USA | 1,735 | 2,909 | 16 | 725 | 22 | 61,797 | 18 | 117 | 10 |
| 34 | Anderson Clayton | USA | 1,425 | 1,557 | ... | ... | ... | ... | ... | 36 | ... |
| 37 | Cargill Inc. | USA | 1,400 | 10,800 | ... | ... | ... | ... | ... | ... | ... |
| 39 | Canada Packers | CAN | 1,383 | 1,635 | 15 | 170 | ... | ... | ... | 21 | ... |
| 41 | Central Soya Inc. | USA | 1,349 | 1,840 | 11 | 236 | 15 | 9,349 | 14 | 38 | 8 |
| 42 | Mitsui & Co. Ltd. | JPN | 1,321 | 12,993 | ... | 558 | ... | ... | ... | 10 | ... |
| 65 | Continental Grain Co. | USA | 950 | 5,000 | ... | ... | ... | ... | ... | ... | ... |
| 69 | 'Det Ostasiatiske Kommpagni | 'DNK | '903 | '3,360 | '... | '... | '... | '... | '... | '... | '... |
| 74 | Ajinomoto | JPN | 823 | 1,113 | ... | ... | ... | ... | ... | ... | ... |
| 75 | Staley A E Manufacturing | USA | 819 | 819 | ... | ... | ... | ... | ... | ... | ... |
| 77 | Foremost McKesson Inc | USA | 800 | 2,695 | ... | ... | ... | ... | ... | ... | ... |
| 88 | Castle and Cooke | USA | 706 | 850 | ... | ... | ... | ... | ... | ... | ... |
| 89 | Bunge and Born | ARG | 700 | 2,000 | ... | ... | ... | ... | ... | ... | ... |
| 104 | Gold Kist | USA | 617 | 892 | ... | ... | ... | ... | ... | ... | ... |
| 128 | Compagnie Financière Lesieur SA | FRA | 517 | 620 | ... | ... | ... | ... | ... | ... | ... |
| 146 | Reckitt & Colman | UK | 435 | 978 | ... | ... | ... | ... | ... | ... | ... |
| 153 | Showa Sangyo | JPN | 413 | 426 | ... | ... | ... | ... | ... | ... | ... |
| 168 | 'Nishin Oil Mills | 'JPN | '361 | '361 | '... | '... | '... | '... | '... | '... | '... |

Notes: ... not available.

Source: Transnational Corporations in Food and Beverage Processing, UN Centre on Transnational Corporations, New York, 1981

The number and relative importance of foreign investments differs widely among host countries. The larger and richer of the developing countries have attracted the greatest number of TNCs affiliates. The 15 countries whose food processing industry output exceeded $US 1 billion were host to an average of 18 TNCs with local processing activities. Brazil and Mexico are each host to more than 40 foreign-based investors.

In the case of processing operations for local markets the TNC normally establishes its affiliate in such a way as to capture a share of the growing market or in an effort to expand its sales in the face of either host country import restrictions or the rising cost of imports. The pattern of development has tended to be that food firms firstly export into foreign markets from home country plants, then arrange foreign licencing, perhaps followed by local investment in processing. The success of any one TNC in an overseas market will often attract rivals, each seeking to protect its market position by similar expansion.

TNCs will establish successful affiliates only if they are allowed to enjoy an advantage over local firms and their potential TNC rivals. The advantage that TNC affiliates traditionally enjoy over local firms is their established access to foreign markets, their expertise and their ability to invest large amounts of capital. The strategies which TNCs follow in establishing themselves in new countries will normally be built around their particular strengths or advantages.

Table 7.2 shows the 28 largest vegetable oil companies with the extent of their investments overseas. Of these firms, 19 have affiliate activities in 38 developing countries (see tables 7.3 and 7.4). Unilever, with affiliates in primary processing and/or consumer-oil products in 24 of these countries is by far the leading firm in the industry, as well as in soap and detergent manufacture, which uses the same raw materials. Although Unilever has significant rivals in many of its developed country markets, the only firm whose developing countries affiliates are of comparable scope is CPC which has affiliates producing edible oil products in 14 developing countries, although apparently not actually crushing oilseeds. Most of the primary oil processors

carry their production downstream into margarine and table oils but only a few of the major consumer product firms, besides Unilever, are so heavily engaged in primary oil processing.

Other large processing firms with significant interests in developing country oil processing include Cargill (Brazil and the Philippines), Bunge and Born (Brazil), Continental Grain (Brazil), Anderson Clayton (Brazil and Mexico), Archer-Daniels-Midland (Brazil) and United Brands (Central America). The activities of the companies operating in Brazil have benefited greatly from the continued expansion of soya bean and from various official incentives to the oil crushing firms. Lesieur, the leading French consumer oil firm draws on African affiliate production for home country use, as does Nisshin oils from its Malaysian operation.

## 7.3 Advances in technology

A continual on-going programme of research and development undertaken largely by equipment manufacturers or sponsored by specific commodity development agencies, ensures that successful research ideas or new materials are gradually converted to practical application and eventually result in marketed hardware or consumables.

Of particular note over the past decade or so have been improvements in both the design and operation of machinery aimed at achieving reductions in energy requirements, undoubtedly a response to the increases in petroleum prices experienced world wide since the formation of OPEC; the more widespread application of fractionation processes to palm oil and the separate marketing of the derived liquid and solid components; and the wider acceptance of physical refining as opposed to the traditional neutralization/bleaching/ deodourization sequence.

Table 7.2. Oils and fats processing: sales and foreign operations of leading firms, 1976

| | | Estimated sales in industry (millions of US dollars) | Estimated foreign production in industry (millions of US dollars) | Number of countries with investment in industry | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Total | Developed market economies | Latin America | Africa West Asia | East Asia Pacific |
| North America | | | | | | | | |
| Archer Daniels Midland | USA | 900 | 200 | 4 | 3 | 1 | - | - |
| Cargill | USA | 900 | 300 | 6 | 3 | 2 | - | 1 |
| Central Soya | USA | 600 | 120 | 2 | 1 | 1 | - | - |
| Esmark | USA | 400 | 60 | 1 | 1 | - | - | - |
| Anderson Clayton | USA | 350 | 180 | 2 | - | 2 | - | - |
| Staley A E | USA | 300 | 30 | 3 | 2 | 1 | - | - |
| Ralston Purina | USA | 200 | 30 | 1 | - | 1 | - | - |
| Gold Kist | USA | 200 | - | 1 | - | 1 | - | - |
| Continental Grain | USA | 100 | 50 | 1 | - | 1 | - | - |
| Nabisco | USA | 100 | - | - | - | - | - | - |
| United Brands | USA | 100 | 50 | 3 | - | 3 | - | - |
| Foremost-McKesson | USA | 75 | - | - | - | - | - | - |
| Castle and Cooke | USA | 75 | 50 | 2 | - | 1 | - | 1 |
| Proctor and Gamble | USA | 75 | 50 | 3 | 1 | 1 | - | 1 |
| General Mills | USA | ... | ... | 1 | - | 1 | - | - |
| Canada Packers | CAN | ... | ... | 3 | 2 | 1 | - | - |
| Europe | | | | | | | | |
| Unilever | Neths/UK | 800 | 500 | 27 | 13 | 4 | 6 | 4 |
| Compagnie Financière Lesieur | FRA | 100 | 30 | 2 | - | - | 2 | - |
| Reckitt and Coleman | UK | 80 | 50 | 3 | 1 | 2 | - | - |
| Rank Hovis McDougall | UK | ... | ... | 1 | 1 | - | - | - |
| Imperial Group | UK | ... | ... | 2 | - | - | 1 | 1 |
| East Asiatic Co. | DNK | ... | ... | 2 | - | - | 1 | 1 |
| Associated British Foods | UK | ... | ... | 1 | 1 | - | - | - |
| Japan | | | | | | | | |
| Nishin Oil Mills | | 350 | 30 | 1 | - | - | - | 1 |
| Ajinomoto | | 270 | 30 | 1 | - | 1 | - | - |
| Mitsui | | 200 | 150 | 1 | 1 | - | - | - |
| Showa Sangyo | | 150 | - | - | - | - | - | - |
| Other | | | | | | | | |
| Bunge and Born | ARG | 300 | 250 | 2 | - | 2 | - | - |

Source: Transnational Corporations in Food and Beverage Processing, UN Centre on Transnational Corporations, New York, 1981

Table 7.3. Vegetable oil processing: sales and foreign operations of leading firms, 1976

| | Number of firms | | | Revenues from vegetable oil processing (millions of US dollars) | | Foreign affiliates in vegetable oil industry | | |
|---|---|---|---|---|---|---|---|---|
| | Total | With foreign operations | | | | Total affiliates | In developed market economies | In developing economies |
| | | Total | In developing countries | Total | Non-domestic | | | |
| All leading firms | 28 | 24 | 19 | 6,795 | 2,310 | 74 | 32 | 42 |
| Eight top firms | 8 | 8 | 7 | 4,300 | 1,640 | 45 | 23 | 22 |
| Home country: | | | | | | | | |
| North America | 16 | 13 | 12 | 4,425 | 1,150 | 32 | 13 | 19 |
| Europe | 7 | 7 | 4 | 1,100 | 700 | 37 | 18 | 19 |
| Japan | 4 | 33 | 2 | 970 | 210 | 3 | 1 | 2 |
| Argentina | 1 | 1 | 1 | 300 | 250 | 2 | - | 2 |
| Other firms | 2 | - | - | 400 | - | - | - | - |

Source: Transnational Corporations in Food and Beverage Processing, UN Centre on Transnational Corporations, New York, 1981

Table 7.4. Distribution of transnational corporation investments in the primary vegetable oil processing and edible oil industries in host developing countries, by size of domestic markets, 1976

| Number of TNC affiliates in country | Size of market for food-processing products[a/] | | | Total number of countries | Total TNC investments |
|---|---|---|---|---|---|
| | Small markets | Medium-sized markets | Large markets | | |
| One firm | Cayman Islands<br>Trinidad and Tobago<br>Liberia b/<br>Malawi<br>United Republic of Cameroon b/<br>Solomon Islands b/ | El Salvador<br>Jamaica<br>Uruguay b/<br>Ghana b/<br>Senegal b/<br>Zimbabwe<br>Sri Lanka | Iran<br>Nigeria<br>Turkey<br>Hong Kong | 17 | 17 |
| Two firms | | Chile<br>Costa Rica b/<br>Honduras b/<br>Nicaragua b/<br>Panama<br>Kenya<br>Zaire b/<br>Singapore | Colombia b/<br>India b/<br>Pakistan b/<br>Thailand b/ | 12 | 24 |
| Three or more firms | | Guatemala (4) b/<br>Peru (3)<br>Malaysia (4) b/ | Argentina (3) b/<br>Venezuela (3) b/<br>Mexico (6)<br>Brazil (9) b/<br>Philippines (4) b/ | 8 | 36 |
| Number of countries | 6 | 18 | 13 | 37 | |
| Number of TNC investments (27 parent firms) | 6 | 34 | 37 | | 77 |

a/ Size of market defined as follows: small markets, total processed food sales in 1975 less than $US 200 million; medium markets between $US 200 million and $US 1,000 million; large markets more than $US 1,000 million.

b/ Countries in which one or more transnational corporations have identified investments in vegetable oil processing (other than corn oil).

Source: Transnational Corporations in Food and Beverage Processing, UN Centre on Transnational Corporations, New York, 1981

In soya bean processing, for instance, innovations include new methods of air recirculation for energy efficiency in drying and modified cracking, as well as new equipment for hulling and flaking. The innovations provide energy savings, better particle size control and improved flake yields. A more recent development applies fluid bed technology to dehulling, conditioning and drying.

Improved solvent extraction designs, applicable to many oilseeds, are leading to reduced solvent losses, and more manufacturers are now marketing extractors that physically turn the bed of seed flakes during the solvent cycle, a procedure that is claimed to increase oil extraction efficiency by exposing fresh surfaces to solvent action so reducing channelling, and lessening solvent retention by the deoiled bran. The process should help reduce the energy requirements of desolventization.

Palm oil extraction and processing technology has made numerous advances in recent years which have resulted in both better quality standards and an increased range of traded products. Palm fruit specific screw presses have virtually replaced hydraulic presses in all but the very smallest mills and the emphasis on good harvesting routines, rapid undelayed bunch sterilization on receipt at the factory, and improved oil drying equipment have all contributed to the reduced free fatty acid levels found in crude oil from the major producers. The increased use of stainless steel and magnetic traps within the factory as minimized contamination with iron and the consequent oxidation of this oil - a major cause of the traditonal bleachability problems. Frequent routine monitoring and analysis ensures the maintenance of high yields and low losses. The development of satisfactory effluent treatment systems has been forced on the industry in many parts of the world by strict pollution control legislation. The introduction of efficient, versatile, fully automated fractionation units developed specifically for palm oil has greatly enhanced penetration of palm oil products into the cooking oil and solid cooking fat/vanaspati markets, hitherto the domain of the more unsaturated vegetable oils, their hydrogenated derivatives and animal fats.

The basis of physical refining is the operation of a traditional deodourizer at higher temperatures and lower pressure so that steam distillation of both the fatty acids and the flavour volatiles from the oil takes place. By eliminating the caustic neutralization stage the major source of neutral oil loss is avoided, capital and operating costs are reduced and soap stock treatment - with the attendant pollution problems - is unnecessary since the fatty acids are recovered directly. To be successful, however, the input oil has to be virtually free of the phosphatides (gums), trace metals and pigments which cause darkening of the oil at the high temperatures employed. Development of physical refining has therefore stimulated improvements in pretreatment degumming, bleaching and, in some cases, dewaxing - improvements which have also been of value in conventional refining procedures. Although initially developed to deal with high levels of free fatty acid in the oils (about 5 per cent ffa), at which level losses during caustic refining become very significant, physical refining has now become the preferred method for all qualities of palm oil. It is also increasingly used for coconut oil and has been successfully applied to maize and sunflower oils. Soya bean and rapeseed oils still present problems due to phosphatide and pigment contents but work is proceeding to develop pretreatment procedures so that refining by the physical route will become possible.

Improvements in expeller design have included the introduction of harder wearing components to reduce maintenance schedules. Manufacturers' model ranges have been extended at both large and small throughput levels and work has been carried out on the development of pre-press expellers which eliminate the need for the other traditional conditioning steps - cooking, rolling, flaking - which are normally required as a pre-requisite for solvent extraction. These developments allow very substantial energy economies. Conventional edible oil processing is turning rapidly away from batch operation and towards continuous refinig procedures. Greater use can then be made of centrifuges and self-cleaning filters for such steps as degumming, dewaxing, water washing; the removal of spent bleaching earth, hydrogenation catalyst and soap stock; clarification/polishing; these steps are conventionally carried out by sedimentation or plate/frame filtration.

Speedier processing and enhanced yields are the major aim for such innovations but the automation that becomes possible with the introduction of such equipment also reduces labour requirements.

With oil palm, fibre by-products (sometimes together with kernels - although these are now almost invariably recovered) have always been used as fuel for the boiler to power the factory; other oilseed by-products such as sunflower shells, cottonseed hulls, and groundnut husks can be similarly used as s result of multi-fuel boiler development, clearly greatly reducing petroleum fuel requirements.

The technological aspects of acqueous coconut processing using fresh coconut meat, which aims at avoiding the quality deterioration of both oil and protein that invariably accompanies copra manufacture, has been intensively examined and much progress made over the past few years. A pilot plant employing the most appropriate comminuting, extraction, separation and drying equipment has been assembled in a USAID funded project in the Philippines and the yield and quality characteristics of a wide range of products - coconut milk, coconut cream, coconut oil, coconut skim milk powder, and a variety of protein and fibre products - evaluated and documented. Doubts, however, still remain on the economics of the process. The increase in revenues obtained by using the process as a source of edible oil is largely attributable to higher value of the better quality oil, but is not sufficient to outweigh the substantial increase in capital costs compared with conventional copra crushing. However, if a high value market can be found or developed for the edible grade protein products, wet processing may become economically viable. Until this is achieved, copra crushing will remain the preferred source of coconut oil.

The market for groundnut cake has continued to be influenced by fear of aflatoxin contamination (a toxic metabolite produced by the mould Aspergillus flavus).

Consequently many countries severely limit the level of groundnut cake in livestock feed or even prohibit the importation of the commodity entirely. Despite many years of research and development no detoxification procedure

has, at the time of writing, been universally accepted but recent investigations into ammoniation technology show great promise. The problem may well be significantly reduced in the not too distant future when appropriate equipment becomes commercially available.

## 7.4 Innovations in raw materials and products

Although improvements in crop yield brought about by breeding work has received most publicity with respect to cereal crops - "the green revolution" - analogous advances have been made with virtually all the world's major oilseeds. Attention has been given to agronomic factors such as yield, disease resistance, maturation period and oil palm, coconut, soya bean, groundnut, rapeseed and sunflower, in particular, have benefitted from such developments. However, improved cultivars developed by breeding programmes have passed, for a variety of technical, economic/political, and sociological reasons, from the plant breeder into commercial use far more rapidly in the developed countries, and in plantation and large-scale farming environments, than in the subsistence and small farmer situation in developing countries.

The chemical characteristics of oilseeds have been the subject of marked innovation in the case of rapeseed and sunflower. Over a period of a decade the so-called double zero varieties of rapeseed have replaced the earlier types in Western Europe and North America. These are low in, or virtually free of erucic acid (previously the dominant and characteristic fatty acid of rapeseed oil) and of glucosinolates (previously the characteristic flavour component of the oil and a limiting factor in the utilization of the oilcake in livestock feed). Both these components are nutritionally undesirable in the crop and their elimination has greatly widened the utilization potential of both oil and oilcake. Lower fibre content cultivars are also now reaching commercial use further enhancing the oilcake value. Breeding work on rapeseed and mustard seed in developing countries is still concentrating entirely on yield factors. Indeed, it is unlikely that glucosinolate reduction or elimination will become important in, for instance, the Indian sub-continent because the pungency imparted to the oil by its presence is a valued characteristic - the bulk of the oil being consumed in the crude form.

With sunflower the innovations have concerned oil content, European and American cultivars now typically have oil contents of around 45 per cent, an improvement largely attributable to a reduction in the hull content of the seed to around 20 per cent. In contrast, varieties grown in Africa have oil contents typically between 25 per cent and 35 per cent due to a hull content at around 40 per cent. Improved tropical varieties developed by breeding programmes are, however, slowly coming into use in these countries.

Cloning of oil palm is now nearing commercial exploitation and similar success with the coconut palm is unlikely to be too far away. These innovations result from many years of intensive research and, in any case, follow spectacular improvements in yield by the development of early maturing, high yielding, disease resistant hybrids of both crops by conventional breeding techniques.

Just over the horizon there are as yet unimagined innovations brought about by the application of genetic engineering concepts still in their infancy. These should bring forward both the possibility of wholesale modifications to fatty acid composition and protein quality as well as all round yield improvements.

Cottonseed breeding has traditionally been guided by consideration of fibre quality and yield; seed characteristics, other than viability and vigour, have generally been ignored. Gossypol-free cottons have been introduced and their widespread use could have important implications for the oilseed industry, notably in the extraction of a less highly pigmented crude oil. Such oil is less costly to refine, has a higher value oilcake, and offers the possibility of preparing edible grade protein products and lecithins for the food industry. These markets are currently dominated by soya bean products.

As well as the move towards trading in oils rather than oilseeds, highlighted in other chapters of this report, there has also been a trend, particularly with palm oil, towards trading in refined oil rather than crude. This has been encouraged by the imposition, by governments anxious to add value to primary products, of differential export tariffs which favour the

more highly processed products. The move has also stimulated research and led to the development of improved handling techniques aimed at reducing hydration, aeration and methal contamination of the oil. It has also led to innovations in storage tank, pipeline and pump construction for the transportation of refined oils, these being more susceptible to deterioration than their crude counterparts.

The most significant new products to appear on the international markets in recent years have been palm olein and palm stearin often available RBD (refined, bleached, deodourized). As mentioned in the previous section, these have resulted from the development and widespread commercial use of fractionation equipment for separating the normally semi-solid palm oil into its liquid (olein) and solid (stearin) fractions. Palm olein, with an iodine value of 55-60, has become a serious competitor to the more unsaturated liquid vegetable oils as a liquid cooking oil, although it is limited here to countries which enjoy a tropical climate and year round high ambient temperatures (75F). Palm stearin, on the other hand, is available in a number of grades, and is increasingly used in tropical countries as a solid cooking fat or vanaspati, replacing animal fats or hydrogenated soya bean oil in this application.

Commercial food companies in the oils and fats field in developed countries pursue continuous research and development programmes aimed at improving consumer products and introducing new ones. An enormous range of cooking oils, cooking fats, bakery and confectionery fats, shortenings, margarines, ice creams, spreads etc. exist each backed by research and development teams investigating modified formulations, costreducing manufacturing procedures, performance improving additives and monitoring production to ensure the maintenance of quality. There are a wide variety of techniques that exist for modifying the characteristics of edible oils, e.g. hydrogenation, trans- and inter-esterification and fractionation and any of them can be employed to vary the performance of a given raw material. A typical example here would be that of cocoa butter and similar confectionery fats which have a characteristic sharp melting point at around body temperature. Although natural cocoa butter would be the commodity of choice in most applications, its high price frequently precludes its use. Thus, a

range of substitutes or replacements, derived most frequently from hydrogenated lauric oils (e.g. palm kernel oil) or inter-esterified palm oil fractions, are manufactured in developed countries. Natural cocoa butter, like vegetable fats such as those derived from shea, sal or illipe, would undoubtedly be used in far greater quantities if its supply and quality were more reliable. Innovations in the formulation of consumer products are shrouded in commercial secrecy and details are not available publicly.

The world-wide increase in petroleum prices has stimulated research into the potential of liquid vegetable oils as fuel for internal combustion engines. Work has been undertaken in many countries into the blending of soya bean, sunflower, rapeseed or coconut oils with diesel fuel for this application.

There have been varying reports of success. Short term performance tests of up to 30 per cent vegetable oil blends are invariably promising but longer term trials tend to reveal carbon deposits in the combustion chamber, injection orfice blocking, ring sticking and a thickening of lubricating oils. Close attention to oil filtration and the removal of phosphatides and waxes may overcome some of these problems. The use of simple fatty acid esters rather than triglycerides also shows promise. Investigations will undoubtedly continue since the concept is very attractive to countries with abundant oilseed supplies but no fossil fuel deposits but, even with technical success, it will be the economics of the technology which will decide its feasibility.

# 8. OPPORTUNITIES FOR AN INTEGRATED DEVELOPMENT STRATEGY IN THE FATS AND OIL INDUSTRY

This chapter refers to the strategy of integrated development and call for the identification of opportunities for its application. It must be emphasized from the outset that an extensive search of available literature provides very little information on integration relating to the oilseed sector and especially in terms of detailed case studies. It is therefore not possible to provide a detailed analysis for the many possible strategies and current patterns of integration existing in developing countries. Instead, an attempt is made to define the concepts involved, and to discuss forms of public and private sector integration referring where possible and in relatively general terms to the experience of individual developing countries or oilseed sectors. The chapter concludes with a brief statement of action needed to identify opportunities for and to provide a fuller analysis of integration than is possible with current information sources.

## 8.1 Definition of integrated development

The term "vertical integration" is commonly used for the amalgamation of firms engaged in different stages of production of the same commodity to achieve greater economic strength and profitability. Although the units may be far apart geographically, both the sources of raw materials and the outlets for the products are assured. In the vegetable oils and fats industry amalgamation may cover the stages of oil crop production, crushing, refining, derivatives production as well as the by-products sectors of animal feed and soap manufacture.

On the other hand, the amalgamation of firms engaged in the same stage of production of the same commodity to achieve greater economic strength and profitability is often referred to as "horizontal integration".[75/] In the

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75/ The concept of horizontal integration may become blurred where firms which produce a range of similar rather than identical products amalgamate. Where such amalgamations involve large scale companies, a wide range of products may be involved and such links are therefore better described by the term 'product differentiation' rather than horizontal integration.

vegetable oils and fats industry the amalgamation may take place at different stages of the production-marketing stages, but most frequently it is applied to the oilcrop production and crushing stages.

Horizontal and vertical integration are therefore two quite distinct concepts, which are unfortunately not always made clear in the literature on integrated development in oilseed processing. This may be partly because the distinction is a particularly difficult one to make in the oilseed sector, which is typified by a number of value added stages, with many co- and by-products at each stage.

The concepts identified above need to be carefully distinguished from the term "integrated development" which is widely used, but seldom closely defined. Integrated development at sector level should be used to refer to the managing of the matrix of factors which affect production of oilseeds, derived products and their markets. Strategies for integrated development will therefore hinge upon the composition of the matrix, the form of government policy objectives and the means used to achieve those objectives in any individual country. It is clear that no single strategy for integrated development exists which can be applied to developing countries as a group. Indeed, a number of strategies are usually available for a single country, i.e. the production, processing and marketing matrix may be manipulated in a variety of ways depending upon the choice of objectives by government and the instruments used to achieve such aims. Horizontal and vertical integration (as defined earlier) may play a role within such strategies under public, quasi-public or private sector initiatives.

## 8.2 The objectives of integrated development

The idea of integrated development, as a concept in planning, has emerged as part of recent attempts to meet certain perceived developmental objectives. In the context of this study, there are particular policy objectives from which developing countries may wish to choose while in pursuit of their integration strategies. These include:

(a) Expansion of the capacity of the oilseed and oilseed products industry in the developing country;

(b) Maximizing potential value added in the oilseed processing industry;

(c) Maximizing the potential benefits from economies of scale;

(d) Maximization of the use of all co- and by-products (including the reduction in waste);

(e) Increased export earnings and/or foreign exchange savings through import substitution;

(f) Developing market strength, partly via the production of more sophisticated downstream products for export and/or import substitution.

In the presence of such objectives, governments may employ a range of policies, for example:

(a) Efforts to control marketing problems associated with the increasing degree of substitution between end-uses of oilseed products from developing countries;

(b) The establishment and support of price stabilization schemes geared to the oil deficit problems of developing countries, in order to promote self-sufficiency;

(c) Agreement on the removal of trade barriers which affect imports of oilseeds and oilseed products in developed countries, plus other measures to maximize export potential of developing countries;

(d) The commitment by the developed countries to seek means of controlling the expansion of their own oilseeds and oilseed products industry;

(e) The provision of improved market information services to developing country producers of oilseed products;

(f) The improvement of the flow of information with regard to technological trends and innovations in the oilseed and oilseed products industry, and other measures to maximize the range and sophistication of products;

(g) The development of ways to monitor national plans for expansion of production of oilseeds and oilseed products in order that situations of over-supply in international markets be either avoided or anticipated sufficiently well in advance for remedial action to be agreed.

Integrated development has as its particular aim a desire to retain as much processing and manufacturing activity within one operating complex, each activity having its own linkage and multiplier effect. This will help retain value added in the developing countries.

Faced with a national demand for vegetable oil, a country can either import the oil, or import the oilseeds and crush them themselves, or produce the oilseeds domestically and crush them themselves. There are circumstances in which importing vegetable oil will be less costly than developing a domestic processing industry. However, the viability of such an industry will be improved if it is planned in such a way as to use all the co- and by-products and make maximum use of material that otherwise would be considered waste. In the case of the co-products, oilcake for example, a domestic or export market must be found. This may involve establishing a new local livestock feed project with all the implications such an investment entails.

Recent research has also shown that other by-products can be recovered from factory residues. Empty oil palm bunches can be burnt to provide an ash rich in potash that can be used as fertilizer. Dried fibre and kernel shell can also be used as a fuel. Sludge can be further refined to yield soap material. Enhanced returns via use of by-products assumes that markets can be found for such products. It is of course essential that these be identified before any project or plan gets under way.

Similarly by integrating backwards, savings can be made. In the oil palm processing industry cultivation must be organized alongside processing as the fruit must be crushed immediately after harvest. However, integration of this sort is also applicable to other oilseeds and will enable savings on the costs of transport, storage, physical deterioration of the seed etc.

It may then be that a particular oilseed project will only be economically viable if it is integrated backwards and forwards so that raw material supply is assured, by-products utilized and markets properly identified. Other objectives of integrated development projects include the desire to bring employment to rural areas and the desire to establish regional equality. A benefit can of course be ascribed to this in the economic schedules.

Whilst a large number of potential advantages stem from the pursuit of integration within the sector, certain drawbacks may also arise, e.g.:

- Reduction in competition at all stages and hence the possiblity for price fixing and excess profits to arise;

- Possible adverse employment effects with movements from small scale to large scale enterprise;

- Possible adverse social effects where production of oilseeds is reorganized;

- Small scale processors, who represent those taking the initiative on the first stage of the entrepreneurial ladder, may be adversely affected by integration of processing units and/or the promotion of medium and large scale enterprises;

- Monopolistic and monopsonistic market characteristics due to concentration of production units into only few hands;

- Rural consumers may suffer where production of oil is organized to primarily serve urban areas.

In pursuing integration objectives, governments therefore need to be aware of potential drawbacks and to implement policy measures to counteract adverse factors.

## 8.3 Opportunities and examples of integration

Opportunities for integration depend upon the matrix of factors which determine the production, processing and marketing of oilseeds and derived products.

In particular countries, the selection of key elements within the production processing and marketing matrix will influence the extent to which integration in its various forms is feasible, i.e.:

- The oilseed agricultural base, including the oilseed mix produced and potential for expansion;

- The economic environment including the relative scale and potential for public and private enterprise and government economic and fiscal policy;

- The extent to which the country concerned has a net (oil) surplus or deficit;

- The overall scale of the oilseed production and processing industry and the degree of sophistication of the latter;

- The size and composition of market demand notably where requirements for sophisticated end products stimulate further downstream processing.

The remainder of this section provides examples of integration related to elements of the production, processing and marketing matrix. This discussion only covers examples of the more narrowly defined horizontal and vertical integration. A broader discussion of integrated development in relation to individual countries is not possible as a result of the dearth of information referred to earlier. However, subsequent sections briefly outline both the nature of sector planning associated with integrated development and the means for identifying suitable countries for study, i.e. those where the potential is likely to be greater.

### 8.3.1 Integration related to oilseed type and levels of production

For all oilseeds under consideration except palm, crushing yields both oil and oilcake as co-products. Linkages between the vegetable oil and oilcake/animal feed industries are therefore strong simply by virtue of such co-production.

The potential for further linkages varies between oilseeds. Cottonseed is itself a by-product of cotton ginning and hence a natural link normally exists between cotton mills and cottonseed crushing enterprises. Links also exist between ginneries and seed cotton production since the former often represents the sole market for the latter. Ginneries may control production directly or indirectly through seed planting, credit etc. Examples of this type of integretation are found in the Sudan and in Afghanistan.

Oil palm has a natural tendency towards vertical integration as oil palm fruits must be processed within hours of harvesting, leading either to strong institutional links between palm growers and palm oil producers or direct ownership of the former by the latter. In contrast, certain oilseeds are much less amenible to vertical linkages. This particularly applies to oilseeds where non-crushing utilization and/or direct human consumption are important, as is the case for coconuts. Since coconut producers often have a variety of market outlets available to them and since relative returns to products other than copra are usuallly significantly higher than for copra itself, little incentive exists for vertical linkages on the part of coconut producers.

### 8.3.2 Integration within the public and private sectors

#### Private sector integration

In a perfectly competitive situation, integrating levels of production and processing might prove difficult. The oilseeds sector, however, is highly concentrated and heavily dominated by TNCs, with their enormous power and influence. Unilever with its vast number of subsidiaries and range of interests is an obvious and good example. This company controls all aspects of its operation, from the original research and development through training

of personnel, purchase and/or production of raw material, crushing, and refining to the final marketing of the many by- and co-products. The company is nearly completely vertically integrated.

The Brazilian case where five TNCs account for 62 per cent of crush is a clear case of horizontal integration. On the other hand, there are industries where a particular firm or organization controls levels of processing from plantation production through crushing, refining and modification while also controlling the by-product sectors of animal feed, soap manufacture and even perhaps fertilizer supply. The international activities of Unilever are a good example of this vertical integration. Clearly there are also cases where both vertical integration and horizontal integration exist together.

Public sector integration

The public sector can be employed in two ways. Firstly, to re-organize and integrate existing units which are operating without contact with each other and therefore without accruing maximum efficiency. It may be that at relatively low cost the state can integrate these units into a whole, minimizing waste and maximizing value added. The agro-industry of the Pelotta region in southern Brazil was reorganized in such a way on UNIDO's advice. The Government provided credit for a range of purposes: the establishment of new and more efficient production, for mergers, for the purchase of modern equipment, for training to improve technical efficiency and for advice on market potential.

A second type of approach which the state can organize is that of identifying a completely new project situation. That is arranging for production of raw materials and for the various steps through processing to marketing of new production. The market research should be carried out first and the production geared to the opportunities identified. Ideally the project should be organized around small modules which can grow with demand and as opportunities present themselves.

An example of this type of approach is a project in Mexico, where the Government in collaboration with UNIDO, identified some 40 opportunities to create food processing plants in two regions of the country. In recent years a number of developing countries have begun to establish soya bean production and processing industries following this approach.

Horizontal integration of the crushing stage often runs counter to government objectives except where state controlled enterprise and/or control by national investors is envisaged. An example of the latter form of integration is provided by recent developments in the Malaysian oil palm industry. Controlling interests have been purchased by Permodalan (the national equity corporation) in TNCs such as Harrison and Crossfield, Guthrie, Barlow and Dunlop. The aim of such purchases is to increase participation by Malay national investing in unit trusts. This example also includes vertical linkages since TNCs used to operate both oil palm estates and oil extraction plants.

A further example of horizontal integration is provided by the Philippines where copra crushing capacity has increasingly come under the control of the United Coconut Oil Millers Incorporated (UNICOM). A major incentive in this case was the need to rationalize the industry in order to reduce surplus capacity. It must be noted that UNICOM, like most institutions operating in the Philippines coconut sector, includes a strong element of private sector participation, and as such, its activities can only be regarded as quasi-public sector.

Horizontal integration may also be promoted indirectly and/or unintentionally, e.g. where governments provide incentives to TNCs which may lead to a situation similar to that of the Brazilian case discussed above.

Public sector encouragement of horizontal integration is more common at the level of oilseed production, and may also be linked to vertical integration as in the Malaysian example quoted earlier. A range of initiatives are apparent ranging from relatively weak linkages in the form of small scale co-operatives to more centralized marketing boards, such as the copra market boards established in most countries in the Asian and Pacific Coconut Community (APCC).

Encouragement of co-operatives may arise where governments do not wish to become directly involved in production, but seek to encourage an integrated approach. In India the success of the AMUL Dairy Cooperative prompted the Government to establish the Gujerat Cooperative Oilseeds Growers Federation (GCOGF) to improve and integrate the production, processing and marketing of oilseeds. Membership of the Federation has increased from 300 in 1980 to 70,500 in 1982. The co-operative offers inputs of seed, fertilizer and other inputs at prices lower than were previously available; it also provides equipment for processing and is planning to build some processing units in addition to the two it currently owns and operates.

In any project, including those described above, the government should also consider the most appropriate fiscal policy, the level and scope of its financial assistance, the extent to which it should become involved in promotion and its possible role in providing technical support.

### 8.3.3 Integration and vegetable oil surplus/deficit developing countries

Horizontal and vertical integration is often well developed in net exporting (i.e. oil surplus) countries. In such countries TNCs are usually well established as a result of the attractions provided by the export trade. Examples have already been referred to earlier, e.g. TNC involvement in Brazil and Malaysia, two of the largest developing country exporters.

Integration is generally less advanced in oil deficit countries. Most of such countries are confronted with problems in achieving increases in oilseed production sufficient to meet domestic consumption needs. Production is often characterized by fragmented distribution of small scale farmers and a similar pattern often applies to oilseed processors. Difficulties are especially acute in major countries, e.g. those in the Indian sub-continent as a result of the sheer scale of the sector.

Thus, whilst in India itself areas of integrated development exist within the sector, there is also much diversity, exemplified by the number of small scale crushers operating. In Bangladesh attempts have been made through

vertical integration, to import products with low added value, e.g. oilseed and crude oils, and to process oils domestically to add value and maximize foreign exchange savings.

In many cases public or quasi-public sector initiatives in deficit countries have taken the form of government encouragement of co-operative enterprise discussed above. Where medium and larger scale processing units exist in the private sector, these have generally sought to ensure supplies by contracting arrangements with producers with few attempts at direct vertical integration into production itself.

### 8.3.4 Integration related to the scale and sophistication of the processing industry, and market demand for products

The scale of operation of an oilseed processing plant is crucial to its amenability to integration. Small scale operations will tend to be more geographically dispersed and hence more difficult to integrate than a more concentrated large operation.

Larger scale enterprise lend themselves more easily to integration, partly because of the opportunities afforded by the wider range and greater sophistication of items which such companies tend to produce. The latter comment particularly applies to vegetable oils where the technical opportunities for further products in a sophisticated consumer economy are very large indeed. At the simplest level, crushing companies may produce soap using the by-products of refining as part of the required feedstock and also manufacture hardened vegetable fats for inclusion in margarines and shortenings. The opportunities for further product development in both edible and inedible items is very considerable as illustrated, for example, by the range produced by Unilever: from reformulation pizzas to aerosol hair sprays.

It must be noted, however, that vertical (and horizontal) integration is by no means inevitable and varying economic and market conditions may produce widely diverging patterns of scale of enterprise and ownership. For example large scale manufacturers of food products may find it financially more viable to 'buy-in' specific vegetable oil product formulations from specialist firms for inclusion in end products, rather than manufacturing such items themselves.

## 8.4 The role of sector planning

Sector planning clearly plays a major role where governments choose to intervene to promote integration within the oilseed sector. Successful implementation of integration strategies will depend upon the effectiveness of such planning. This section provides an outline of requirements in relation to planning in the oilseed sector.

In the context of the policy objectives discussed earlier, the first task of sector planning is to set targets for production and consumption of vegetable oilseeds and their products. In the case of exporting countries, this will involve estimating the excess of production over consumption available for export, as well as consideration of the size of and potential for developing export markets. For importing countries target consumption levels need to be identified and, in relation to the domestic production potential, the required level of imports established.

Planning in the oilseed sector is relatively complex when compared with some other commodities. For example, target consumption levels of vegetable oils need to be stablished within the context of associated products, i.e. oilseeds and oilcakes, as well as in relation to substitutes, i.e. animal fats. This highlights the general need to ensure intersectoral compatibility within the overall plan framework. Similarly, vegetable oils may act as substitutes for each other, the choice between them depending on such factors as consumer preference and price. The increasing substitutability between vegetable oil products made possible by advances in technology means that targeting has become an increasingly complex exercise.

Once the inital targets for supplies have been established, the sector plan must then be developed to consider how these targets are to be met. As the first step, development of oilseed production should be examined. The range of factors to be considered include the availability of land, suitability of soil, selection of seed varieties, the place of oilseeds in present farming systems and the profitability of production when compared with other crops. The next step is to examine the processing infrastructure. How much processing capacity is available at present and how much more investment will be required to handle the proposed future production?

Any new projects would involve undertaking feasibility studies to examine the financial and economic returns to new investment. Within such studies it is necessary to consider available technologies and scales, establishment costs, working capital requirements, operating costs, management and staffing levels etc. To link the agricultural and industrial developments and subsequently to market the product will entail the development of marketing systems. This will involve consideration of the physical infrastructure, i.e. roads and vehicles as well as institutional factors, e.g. the need for a marketing organization, marketing regulations, pricing systems etc. In addition, sector development plans need to consider the whole range of supporting services which will include credit facilities, training requirements, needs for technical assistance etc.

In undertaking the various planning steps, certain constraints on the development of the sector will be identified. In the light of these constraints it may be necessary to amend the initial supply targets so that the final plan presents the most realistic estimates, taking into account all the available information. It is precisely for failing to establish realistic estimates of the future supply/demand situation that developing countries have often been criticized in the past. Those with a declared policy of self-sufficiency in vegetable oilseed products often only assess their imports requirements annually. The result is that imports tend to be organized at comparatively short notice on an ad hoc basis and cover no more than the period between domestic crops. Such short term decision making almost always incurs a cost through the payment of higher prices than are strictly necessary. It also means that supplies are more likely to be bought form the large TNCs which have greater flexibility as suppliers, than from other developing countries. If, through more realistic planning and regional co-operation, a long term programme for importing vegetable oilseed products could be worked out, the importing countries would almost certainly be in a position to arrange imports more cheaply and in larger quantities, as well as looking to other developing countries as suppliers.

This problem can be made worse by planners who, in the drive for self-sufficiency, may project unrealistic increases in production totally out of proportion to historical performance. Commonly little significance is

attached to the relative prices of domestic supplies and imports, and of the quite high foreign exchange costs associated with increasing domestic production in the form of imported fuel, fertilizer, machinery and equipment etc. are not taken into account.

To a degree short term planning is also characteristic of some exporters, especially when the crop grown is an annual one (tree crop production has the advantage of allowing greater accuracy of crop forecasting). Unpredictable growing conditions make annual fluctuations in production inevitable, but governments must make a realistic assessment of their export potentials taking into account the levels of world market prices when compared to domestic costs of production.

A sound sector development plan alone will be insufficient to ensure that the general policy objectives set for the sector are met. It is the responsibility of government to create the conditions to ensure that investment and hence development is stimulated.

## 8.5 Final considerations

Limitations in data and the complexity of the interaction of factors affecting integration preclude a detailed country by country consideration of integration in the oilseed sector. However, certain broad conclusions may be drawn from the foregoing discussion.

It is evident that no single integration strategy exists or is applicable to all developing countries. In practice a wide range of strategies are appropriate to different countries as a result both of differences in the production, processing and marketing matrix of the sector and in the range of objectives held by government.

Whilst it is not possible to generalize with regard to integration strategy, certain elements of the production, processing and marketing matrix tend to influence the potential for the more narrowly defined concepts of vertical and horizontal integration. For example, certain oilseeds may be more 'naturally' amenable to vertical integration (e.g. oil palm) and/or

horizontal integration (e.g. cottonseed). Further examples of both horizontal and vertical integration appear to be correlated with the scale and sophistication of the oilseed processing sector and the nature of demand for oilseed products, especially in net exporting countries where the role of TNCs is especially important.

An analysis of integration strategy can be undertaken effectively only in the context of individual country studies. The potential for integration will clearly vary between countries in relation to differences in the production, processing and marketing matrix in each case. Whilst the detailed concept of the matrix needs further refining certain broad comments can be made here to indicate the need and feasibility of further study, particularly to short list candidate countries where integration may be a feasible proposition.

It has already been noted that horizontal and vertical integration tend to be more advanced in the large scale net exporting countries. Certain of these countries, e.g. Malaysia, have further developed an integration policy to draw together such developments in relation to perceived national objectives. Since most exporters have gone some distance towards achieving integration, the potential for further development is greater amongst net deficit/importing countries.

Further studies on integration might therefore be concentrated on the oil deficit group of developing countries. Within this group, a wide variety of conditions are experienced. At one end of the spectrum are the small scale producers (often island economies) which tend to cultivate a narrow range of oilseeds. (In many such cases coconuts are the sole oilseed produced.) The possibilities for a broad integration strategy in these countries are clearly constrained. At the other end of the spectrum, some countries typified by those on the Indian sub-continent, have very large scale oilseed processing sectors and produce a wide range of seeds and derivatives. The need for an integration strategy in such cases is much greater although so also will be its complexity. Countries within this sub-group might therefore be the most suitable in which to carry out further research.

Further work is required to refine the production, processing and marketing for individual countries. From such matrices a short-list of countries may be selected including those which exhibit the greatest potential gains from integration. Subsequent detailed country studies could then be undertaken in order to identify and promote appropriate integration strategies.

Annex 1a

Methodology employed to estimate net trade expansion effects of tariff removal

1. Estimates of net trade expansion effects available to developing and developed market economy countries from a removal of tariff protection by eight major importers include only net gains and/or losses accruing to exporters after tariffs are eliminated in the 1980 year-base period. Previous benefits experienced in earlier periods from tariff liberalization and the GSP programmes are not included.

2. Trade creation effects are calculated in the usual way, applying import demand price elasticities (dM) to the percentage change in price ($dt/(1 + t)$) induced by nominal tariff (t) removal, and multiplying this product by the value of base-period imports (Mo), to yield the resulting change in imports (dM), using:

$$(1) \qquad dM = Mo \quad \frac{dt}{(1 + t)}$$

The tariff remover's import increases from non-beneficiaries of the GSP are arrived at by substituting the MFN tariff rate ($t_{MFN}$) and the MFN base period import value ($M_{MFN}$) for (Mo) and (t) in equation (1) above. Gains for developing country GSP beneficiaries who faced non-zero GSP duties in the base period are obtained from equation (1) as well, by substituting the base-period GSP import level ($M_{GSP}$) for (Mo), and employing ($dt_{GSP}/(1 + t_{MFN})$) as the tariff induced price change. The GSP duty is ($t_{GSP}$). Since the degree of substitutibility between domestically produced goods and imports in the importer is assumed to be the same for each import source, the same import demand elasticity can be used for each source of supply.

3. Trade diversion is calculated from:

$$(2) \qquad dM = M_{MFN} \quad \frac{Ec\ d(t_{MFN} - t_{GSP})}{(1 + t_{MFN})}$$

where ($t_{MFN} - t_{GSP}$) is the preference margin, and Ec is the elasticity of substitution between two supply sources (those facing MFN rates and those receiving preferences) for each product in each market. Preference grantors typically use limitations such as tariff quotas, maximum country amounts, or the right to invoke the escape clause (EEC and Japan) to reduce the effective coverage of the GSP scheme. However, adjustments to trade creation for ceilings or limitations on GSP trade need not be performed in the present study. These limitations were not a constraint for products covered in 1980.

4. All variables used in the present study, with the exception of elasticities, were available from UNCTAD data files. Elasticity estimates employed were those used in a recent study which estimated the effects of the Tokyo Round on trade flows.[76/] A consistent set of own-import demand price elasticities for vegetable oils and fats were available for each importer, but not at the tariff line level of aggregation. Import demand elasticities were not available for oilseeds. Own-elasticity import demand estimates for fats and oils were applied in each country to all product groups at the CCCN tariff line level of aggregation.

5. Substitution elasticity estimates are subject to even less availability, and in addition, are considered to be less reliable than import demand price elasticity estimates. A probable range of trade diversion estimates was generated using one high (-2.5) and one low (-1.5) substitution elasticity estimate.[77/] Calculations were performed at tariff line levels, and results were summed to yield the estimates presented in table 3.11.

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76/ See Cline, R. William, Noboru Kawanabe, T.D.M. Kronsjo and Thomas Williams, Trade Negotiations in the Tokyo Round: A Quantitative Assessment (Washington, D.C.: The Brookings Institute, 1978), p. 58.

77/ Cline, et al., op. cit., employed a substitution elasticity estimate of (-2.5). The substitution elasticity estimates used in the present study fall within the range of estimates in the literature surveyed by Cline.

6. Although this partial equilibrium approach could not be modified to take into account second-order price and income effects, the impact of non-tariff measures, increasing per unit production costs, or the possibility of differences in substitution elasticities between country pairs, results in table 3.11 are considered to be the best available, but should still be interpreted with the afore-mentioned shortcomings in mind.

## Annex 1b

### Econometric analysis of the relationship between the per capita consumption of total fats and per capita income

Previous research has established a functional relationship between the per capital consumption and per capital income.[1/] The annual per capita consumption tends towards a saturation level of around 30 kg, increments in consumption are first relatively large as income grows but, as the saturation level is being approached, the increase slows down. These results were used to specify the following consumption function.

(1) $C = a - b/Y^e + u$ where

C = per capita consumption of total fats

Y = per capita income (operationally GDP per capita)

e = .05

u = random error term with zero mean

a, b = parameters to be estimated

The elasticity e = .05 was chosen to allow the function to approach its asymptote (saturation level) so that the best possible fit would be obtained between the empirical data and the estimated model.

The model was estimated by Ordinary Least Squares using a sample data on 48 countries applying standard assumptions regarding population and income growth (see table A.1). The following results described the econometric properties of the estimated model.

| Parameter | Parameter estimate | Standard error | t for $H_o$ parameter = 0 |
|---|---|---|---|
| a | 1378.130 | 142.309 | 9.684 |
| b | 1703.562 | 197.264 | 8.636 |

$R^2$ = .6185

F (2,46) = 74.580

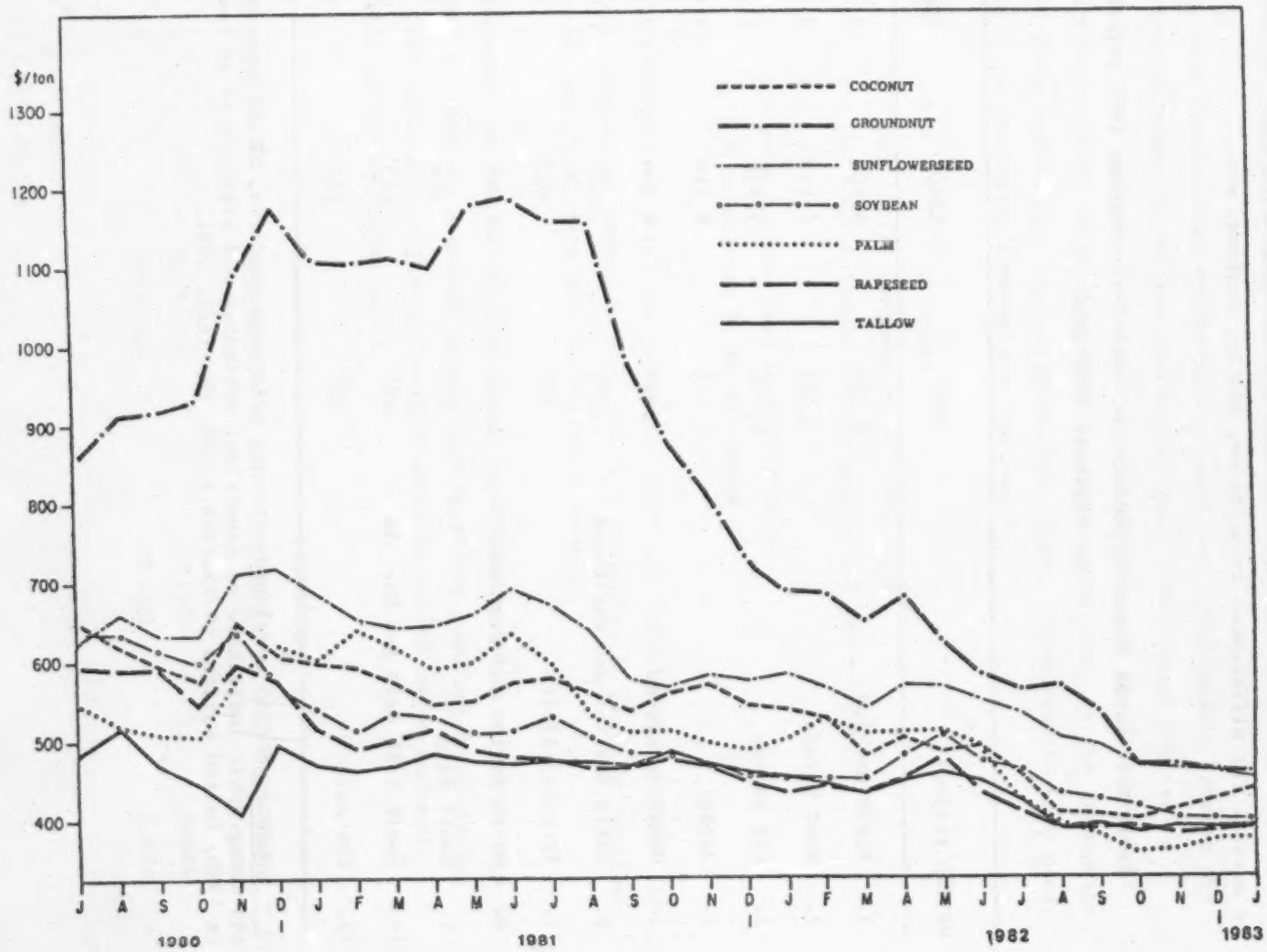
Thus, the estimated parameters are very stable and the fit of the model is good. Moreover, since the model specification is soundly based on previous economic and dietary research, there is some justification in using the model for forecasting purposes, at least at an aggregated, regional level. For individual countries, additional variables would have to be added to the model to account for differences in policies, dietary customs, etc.

Table A.1 Gross domestic product per capita at constant 1975 prices, by regions, 1980-2000

| UNITAD regions | | 1980 | 1990 | 2000 |
|---|---|---|---|---|
| 1. | North America | 8,068 | 9,904 | 12,387 |
| 2. | West Europe | 5,525 | 6,252 | 7,171 |
| 3. | CPE Europe | 2,584 | 3,838 | 5,776 |
| 4. | Japan | 5,473 | 9,310 | 15,976 |
| 5. | Other developed | 3,514 | 4,054 | 4,703 |
| 6. | Latin America and Caribbean | 1,321 | 1,845 | 2,625 |
| 7. | Tropical Africa | 359 | 403 | 452 |
| 8. | North Africa and West Asia | 1,151 | 1,398 | 1,813 |
| 9. | South Asia | 157 | 184 | 219 |
| 10. | South East Asia and Oceania | 495 | 623 | 979 |
| 11. | CPE Asia | 227 | 293 | 440 |

Source: UNITAD model projections; reference scenario, UNIDO secretariat and demographic indicators of countries: estimates and projections as assessed in 1980, United Nations ST/ESA/SER.A./82, New York, 1982.

Appendix 1. International market prices for selected edible oils and fats, 1980-1983

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